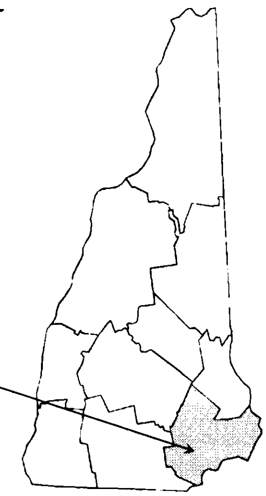
FLOOD INSURANCE STUDY

VOLUME 1 OF 3

ROCKINGHAM COUNTY, NEW HAMPSHIRE
ALL JURISDICTIONS



Rockingham County

COMMUNITY NAME	COMMUNITY NUMBER	COMMUNITY NAME	COMMUNITY NUMBER
Atkinson, Town of	330175	New Castle, Town of	330135
Auburn, Town of	330176	Newfields, Town of	330228
Brentwood, Town of	330125	Newington, Town of	330229
Candia, Town of	330126	Newmarket, Town of	330136
Chester, Town of	330182	Newton, Town of	330240
Danville, Town of	330199	North Hampton, Town of	330232
Deerfield, Town of	330127	Northwood, Town of	330855
Derry, Town of	330128	Nottingham, Town of	330137
East Kingston, Town of	330203	Plaistow, Town of	330138
Epping, Town of	330129	Portsmouth, City of	330139
Exeter, Town of	330130	Raymond, Town of	330140
Fremont, Town of	330131	Rye, Town of	330141
Greenland, Town of	330210	Salem, Town of	330142
Hampstead, Town of	330211	Sandown, Town of	330191
Hampton Falls, Town of	330133	Seabrook Beach Village District	330854
Hampton, Town of	330132	Seabrook, Town of	330143
Kensington, Town of	330216	South Hampton, Town of	330193
Kingston, Town of	330217	Stratham, Town of	330197
Londonderry, Town of	330134	Windham, Town of	330144

MAY 17, 2005

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
33015CV001A

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS components.

Initial Countywide FIS Effective Date: May 17, 2005

Revised Countywide FIS Date:

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FLOOD INSURANCE STUDY
ROCKINGHAM COUNTY, NEW HAMPSHIRE (ALL JURISDICTIONS)

1.0 INTRODUCTION

1.1 Purpose of Study

This countywide Flood Insurance Study (FIS) investigates the existence and severity of flood hazards in, or revises and updates previous FISs/Flood Insurance Rate Maps (FIRMs) for the geographic area of Rockingham County, including: the City of Portsmouth; the Towns of Atkinson, Auburn, Brentwood, Candia, Chester, Danville, Deerfield, Derry, East Kingston, Epping, Exeter, Fremont, Greenland, Hampstead, Hampton, Hampton Falls, Kensington, Kingston, Londonderry, New Castle, Newfields, Newmarket, Newton, Newington, North Hampton, Northwood, Nottingham, Plaistow, Raymond, Rye, Sandown, Salem, Seabrook, South Hampton, Stratham, and Windham; and the Seabrook Beach Village District (hereinafter referred to collectively as Rockingham County).

This FIS aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This FIS has developed flood risk data for various areas of the county that will be used to establish actuarial flood insurance rates. This information will also be used by Rockingham County to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP), and will also be used by local and regional planners to further promote sound land use and floodplain development. Minimum floodplain management requirements for participation in the NFIP are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some States or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this FIS are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

This FIS was prepared to include the incorporated communities within Rockingham County in a countywide FIS. Information on the authority and acknowledgments for each jurisdiction included in this countywide FIS, as compiled from their previously printed FIS reports, is shown below.

Atkinson, Town of:	the hydrologic and hydraulic analyses for the FIS report dated April 2, 1993, were prepared by the U.S. Geological Survey (USGS) for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. EMW-88-E-2738,

Project Order No. 4. That work was completed in August 1991. The hydrologic and hydraulic analyses for Island Pond were taken from the FIS for the Town of Derry (FEMA, 1981). The hydrologic and hydraulic analyses for Bryant Brook were taken from the FIS for the Town of Plaistow (FEMA, April 1981).

Brentwood, Town of: the hydrologic and hydraulic analyses for the FIS report dated October 15, 1980, were prepared by the Soil Conservation Service (SCS) for the Federal Insurance Administration (FIA), under Inter-Agency Agreement No. IAA-H-17-78. That work was completed in May 1979. The hydrologic and hydraulic analyses for the FIS report dated May 4, 2000, were prepared by the USGS for FEMA, under Inter-Agency Agreement No. EMW-97-1A-0155, Project Order No. 1. That work was completed in June 1998.

Derry, Town of: the hydrologic and hydraulic analyses for the FIS report dated April 15, 1980, were prepared by Anderson-Nichols and Company, Inc., for the FIA, under Contract No. H-3989. That work was completed in March 1978.

Epping, Town of: the hydrologic and hydraulic analyses for the FIS report dated October 15, 1981, were performed by the SCS for FEMA, under Inter-Agency Agreement No. IAA-H-17-78, Project Order No. 15. That work was completed in September 1979.

Exeter, Town of: the hydrologic and hydraulic analyses for the FIS report dated November 17, 1981, were prepared by Stone & Webster Engineering Corporation for FEMA, under Contract No. H-4772. That work was completed in May 1980.

Fremont, Town of: the hydrologic and hydraulic analyses for the FIS report dated June 19, 1989, represent a revision of the original analyses prepared by the SCS for FEMA, under Inter-Agency Agreement No. IAA-H-17-78, Project Order No. 15. The work for the original analyses were completed in May 1979. The hydrologic and hydraulic analyses for Spruce Swamp were prepared by Dewberry & Davis LLC, under agreement with FEMA. That work was completed in June 1988.

Greenland, Town of:	the hydrologic and hydraulic analyses for the FIS report dated May 17, 1989, were performed by the SCS for FEMA, under Inter-Agency Agreement No. EMW-86-E-2225, Project Order No. 01. That work was completed in September 1987.
Hampstead, Town of:	the hydrologic and hydraulic analyses for the FIS report dated June 16, 1993, were prepared by the USGS for FEMA, under Inter-Agency Agreement No. EMW-88-E-2738, Project Order No. 4. That work was completed in August 1991. The flooding information for Island Pond was taken from the FIS for the Town of Derry (FEMA, 1981).
Hampton, Town of:	the hydrologic and hydraulic analyses for the FIS report dated July 3, 1986, were prepared by Stone & Webster Engineering Corporation for FEMA, under Contract No. H-4772. That work was completed in January 1984.
Hampton Falls, Town of:	the hydrologic and hydraulic analyses for the FIS report dated October 15, 1981, were prepared by Stone & Webster Engineering Corporation for FEMA, under Contract No. H-4772. That work was completed in April 1980.
Kingston, Town of:	the hydrologic and hydraulic analyses for the FIS report dated April 15, 1992, were prepared by the USGS for FEMA, under Inter-Agency Agreement No. EMW-87-E-2548, Project Order No. 1A. That work was completed in July 1989.
Londonderry, Town of:	the hydrologic and hydraulic analyses for the FIS report dated May 5, 1980, were prepared by Anderson-Nichols & Company, Inc., for the FIA, under Contract No. H-3989. That work was completed in March 1978.
New Castle, Town of:	the hydrologic and hydraulic analyses for the FIS report dated August 5, 1986, were prepared by Stone & Webster Engineering Corporation for FEMA, under Contract No. H-4772. That work was completed in April 1984.
Newfields, Town of:	the hydrologic and hydraulic analyses for the FIS report dated June 5, 1989, were prepared by the SCS for FEMA, under Inter-Agency Agreement No. EMW-86-E-2225, Project Order No. 01. That work was completed in September 1987.

New Market, Town of:	the hydrologic and hydraulic analyses for the FIS report dated May 2, 1991, were prepared by the USGS for FEMA, under Inter-Agency Agreement No. EMW-85-E-1823, Project Order No. 20. That work was completed in August 1989.
North Hampton, Town of:	the hydrologic and hydraulic analyses for the FIS report dated June 3, 1986, were prepared by Stone & Webster Engineering Corporation for FEMA, under Contract No. H-4772. That work was completed in February 1984.
Plaistow, Town of:	the hydrologic and hydraulic analyses for the FIS report dated October 15, 1980, were prepared by Anderson-Nichols & Company, Inc., for the FIA, under Contract No. H-4589. Approximate flood boundaries for portions of Seaver Brook and several unnamed streams and swampy areas were determined in August 1976, by Michael Baker, Jr. Inc., under contract to the FIA. That work was completed in October 1978.
Portsmouth, City of:	the hydrologic and hydraulic analyses for the FIS report dated November 17, 1981, were prepared by Stone & Webster Engineering Corporation for FEMA, under Contract No. H-4772. That work was completed in April 1980.
Raymond, Town of:	the hydrologic and hydraulic analyses for the FIS report dated October 15, 1981, were prepared by the SCS for FEMA, under Inter-Agency Agreement No. IAA-H-17-78. That work was completed in September 1979. The hydrologic and hydraulic analyses for the FIS report dated April 15, 1992, were prepared by Rivers Engineering Corporation for FEMA, under Contract No. EMW-89-C-2821, Project Order No. R89508. That work was completed October 1989. The hydrologic and hydraulic analyses for the FIS report dated May 2, 1995, were prepared by Roald Haestad, Inc., for FEMA, under Contract No. EMW-90-C-3126. That work was completed in March 1993.
Rye, Town of:	the hydrologic and hydraulic analyses for the FIS report dated June 17, 1986, were prepared by Stone & Webster Engineering Corporation for FEMA, under Contract No. H-4772. That work was completed in March 1984.

Salem, Town of:	the hydrologic and hydraulic analyses for the December 1978 FIS report and June 15, 1979, FIRM (hereinafter referred to as the 1979 FIS), were prepared by the U. S. Army Corps of Engineers (USACE), New England District, for the FIA, under Inter-Agency Agreement No. 1AA-H-7-76, Project Order No. 24. That work was completed in August 1977. The hydrologic and hydraulic analyses for the FIS report dated April 6, 1998 were prepared by the U. S. Department of Agriculture, Natural Resources Conservation Service (NRCS), for FEMA, under Contract No. EMW-94-E-4437. That work was completed in September 1995.
Seabrook, Town of:	the hydrologic and hydraulic analyses for the FIS report dated June 17, 1986, were prepared by Stone & Webster Engineering Corporation for FEMA, under Contract No. H-4772. That work was completed in December 1983.
Seabrook Beach Village District:	the hydrologic and hydraulic analyses for the FIS report dated August 5, 1986, were performed during the preparation of the FIS for the Town of Seabrook by Stone & Webster Engineering Corporation for FEMA, under Contract No. H-4772. The Town of Seabrook study was completed in December 1983.
South Hampton, Town of:	the hydrologic and hydraulic analyses for the FIS report dated July 15, 1992, were prepared by the USGS for FEMA, under Inter-Agency Agreement No. EMW-89-E-2997, Project Order No. 5. That work was completed in September 1990.
Stratham, Town of:	the hydrologic and hydraulic analyses for the FIS report dated May 17, 1989, were prepared by the SCS for FEMA, under Inter-Agency Agreement No. EMW-86-E-2225, Project Order No. 1. That work was completed in September 1987.
Windham, Town of:	the hydrologic and hydraulic analyses for the FIS report dated were performed by Anderson-Nichols & Company, Inc., for the FIA, under Contract No. H-3989. That work was completed in March 1978.

The authority and acknowledgments for the Towns of Auburn, Candia, Chester, Danville, Deerfield, East Kingston, Kensington, Newington, Northwood, Nottingham, and Sandown are not available because no FIS reports were ever published for those communities.

The digital base mapping information was derived from USGS Digital Orthophoto Quadrangles (DOQs) produced at a scale of 1:12,000 from photography dated 1998 or later.

The digital FIRM was produced using New Hampshire State Plane Coordinate system, FIPS Zone 2800, referenced to the North American Datum of 1983 (NAD 83), GRS80 spheroid.

1.3 Coordination

Consultation Coordination Officer's (CCO) meetings may be held for each jurisdiction in this countywide FIS. An initial CCO meeting is held typically with representatives of FEMA, the community, and the study contractor to explain the nature and purpose of a FIS, and to identify the streams to be studied by detailed methods. A final CCO meeting is held typically with representatives of FEMA, the community, and the study contractor to review the results of the study.

The dates of the initial and final CCO meetings held for all jurisdictions within Rockingham County are shown in Table 1, "Initial and Final CCO Meetings."

TABLE 1 - INITIAL AND FINAL CCO MEETINGS

Community Name	Initial CCO Meeting	Final CCO Meeting
Town of Atkinson	August 31, 1991	March 23, 1992
Town of Brentwood	July 15, 1997	*
Town of Derry	March 1976	February 13, 1979
Town of Epping	January 4, 1978	August 19, 1980
Town of Exeter	April 19, 1978	June 11, 1981
Town of Fremont	January 4, 1978	October 31, 1979
Town of Greenland	October 1, 1985	March 21, 1988
Town of Hampstead	August 31, 1987	January 21, 1992
Town of Hampton	April 19, 1978	January 16, 1985
Town of Hampton Falls	April 18, 1978	April 15, 1981
Town of Kingston	*	August 15, 1990
Town of Londonderry	March 1976	March 28, 1979
Town of New Castle	April 19, 1978	January 21, 1985
Town of Newfields	October 22, 1985	July 8, 1988
Town of Newmarket	February 1985	April 4, 1990
Town of North Hampton	April 19, 1978	January 16, 1985
Town of Plaistow	*	September 10, 1979
City of Portsmouth	April 19, 1978	June 11, 1981
Town of Raymond	December 9, 1992	*
Town of Rye	April 19, 1978	April 12, 1985
Town of Salem	August 3, 1993	October 17, 1996
Town of Seabrook	April 18, 1978	December 5, 1984

*Data not available

TABLE 1 - INITIAL AND FINAL CCO MEETINGS - continued

Community Name	Initial CCO Meeting	Final CCO Meeting
Seabrook Beach Village District	*	September 11, 1985
Town of South Hampton	*	May 28, 1991
Town of Stratham	October 22, 1985	June 20, 1988
Town of Windham	March 1976	October 16, 1978

*Data not available

For this countywide FIS, the communities in Rockingham County were notified by FEMA in a letter dated July 10, 2002, that FEMA would be preparing a FIS and FIRM for Rockingham County (All Jurisdictions), New Hampshire. The letter stated that the effective FIRMs and Flood Hazard Boundary Maps (FHBMs) of these communities would be digitally converted to a format that conforms to FEMA's Digital FIRM (DFIRM) specifications. No new hydrologic and hydraulic analyses were prepared.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the geographic area of Rockingham County, New Hampshire.

All or portions of the flooding sources listed in Table 2, "Flooding Sources Studied by Detailed Methods," were studied by detailed methods. Limits of detailed study are indicated on the Flood Profiles (Exhibit 1) and on the FIRM (Exhibit 2).

TABLE 2 - FLOODING SOURCES STUDIED BY DETAILED METHODS

Adams Pond	Great Bay	Meadow Pond
Atlantic Ocean	Great Pond	Nesenkeag Brook
Beaver Brook	Hornes Brook	Nudds Canal
Beaver Lake	Hill Brook	Pickering Brook
Black Brook	Hog Hill Brook	Piscassic River
Bryant Brook	Hidden Valley Brook	Piscataqua River
Cohas Brook	Island Pond	Policy Brook
Country Pond	Kelly Brook	Porcupine Brook
Cunningham Brook	Lamprey River	Porcupine Brook Tributary
Drew Brook	Little Cohas Brook	Powwow Pond
Dudley Brook	Little River No. 1	Powwow River (Downstream Reach)
Exeter River	Little River No. 2	Powwow River (Upstream Reach)
Flatrock Brook	Little River No. 3	Shields Brook
Golden Brook	Lower Ballard Pond	
Grassy Brook	Lower Beaver Lake	

TABLE 2 - FLOODING SOURCES STUDIED BY DETAILED METHODS - continued

Shop Pond	Tributary E to Little Cohas Brook	Tuxbury Pond
Spicket River	Tributary F to Beaver Lake	Upper Ballard Pond
Squamscott River	Tributary G to Beaver Brook	Upper Beaver Brook
Taylor Brook (including Ballard Pond)	Tributary H to Drew Brook	Wash Pond
Taylor River	Tributary H to Nesenkeag Brook	Wash Pond Tributary
Tide Mill Creek	Tributary J to Black Brook	Winnicut River
Tributary C to Beaver Brook	Tributary O to Beaver Brook	West Channel Policy Branch
Tributary E to Beaver Lake		World End Brook
		World End Pond

This FIS also incorporates the determinations of letters issued by FEMA resulting in map changes (Letter of Map Revision [LOMR], Letter of Map Revision - based on Fill [LOMR-F], and Letter of Map Amendment [LOMA], as shown in Table 3, "Letters of Map Change."

TABLE 3 - LETTERS OF MAP CHANGE

Community	Flooding Source(s)/Project Identifier	Effective Date	Type
Portsmouth, City of	Pickering Brook/Ocean Road Development Corporation Project	October 6, 1999	LOMR
Rye, Town of	Atlantic Ocean/Brown Property shore protection project	February 15, 2001	LOMR
Salem, Town of	West Channel Policy Brook/ Powers Builders property	September 15, 1999	LOMR
Epping, Town of	Lamprey River/ downstream of Prescott Road bridge	September 7, 1993	BADL

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction.

Numerous flooding sources in the county were studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and Rockingham County.

For this study, several areas of approximate flooding were extended in order to match the approximate flooding across community corporate limits within

Rockingham County and across the county boundary from contiguous counties. The delineation involved the use of topographic maps at a scale of 1:24,000 and contour intervals of 10 and 20 feet (U.S. Department of Interior, 1966, et cetera; 1950, et cetera.).

Three Little Rivers exist in Rockingham County. For clarification purposes, they have been renamed in the FIS as follows: Little River in the Town of Exeter is Little River No. 1; Little River in the Town of North Hampton is Little River No. 2; Little River in the Town of Plaistow is Little River No. 3. In addition, Tributary D in the Town of Londonderry has been renamed in the FIS as Tributary O to Beaver Brook.

2.2 Community Description

Rockingham County is located in southeastern New Hampshire. In Rockingham County, there are 38 communities. The Towns of Northwood, Nottingham, and Deerfield are located in the northwestern section of the county. The Towns of Epping, Newmarket, and Newfields are located in the northern section of the county. In the eastern part of the county, lie the City of Portsmouth and the Towns of Newington, Greenland, New Castle, Stratham, Exeter, North Hampton, and Rye. The Seabrook Beach Village District and the Towns of Hampton, Hampton Falls, and Seabrook are located in the southeastern part of the county. The Towns of Brentwood and Fremont are located in the center of Rockingham County. In the southern section of the county lie the Towns of Sandown, Danville, Kingston, East Kingston, Kensington, Hampstead, Atkinson, Plaistow, Newton, and South Hampton. In the southwestern section of the county, the Towns of Derry, Londonderry, Windham, and Salem are located. The Towns of Candia, Raymond, Auburn, and Chester are located in the western part of Rockingham County.

Rockingham County is bordered to the north by communities of Strafford County: the City of Durham and the Towns of Strafford, Barrington, Lee, and Dover. To the northeast, the county is bordered by communities of York County, Maine: the Towns of Kittery and Eliot. It is bordered to the northwest by communities of Merrimack County: the Towns of Pittsfield, Epsom, Allenstown, and Hooksett. Rockingham County is bordered to the southwest by communities of Hillsborough County: the City of Manchester and the Towns of Bedford, Merrimack, Litchfield, Hudson, and Pelham. To the south, the county is bordered by the communities of Essex County, Massachusetts: the Cities of Methuen and Haverhill and the Towns of Amesbury and Salisbury.

According to the U.S. Census Bureau, the estimated population of Rockingham County was 277,359 in 2000.

The topography of the county is flat coastal plains to the east, gently rolling hills to the south and center of the county, and more hilly terrain to the northwest. The Atlantic coast is characterized by sandy beaches, rocky headlands, wetlands, and offshore reefs and ledges. The development in Rockingham County is primarily residential.

The climate of the town can be classified as modified continental. The average annual temperature is approximately 47 degrees Fahrenheit (U.S. Department of

Commerce). The average rainfall of the county is 42 inches per year (FEMA, 1993; April 1982; July 1986).

The main flooding sources in Rockingham County are the Atlantic Ocean to the east, Exeter River in the east, Lamprey River in the center, Little Cohas Brook in the west, and Beaver Brook in the south.

2.3 Principal Flood Problems

Past history within the county indicates that major floods occur during the spring, fall, and winter seasons. Some of the most severe flooding occurs in early spring as a result of snowmelt and heavy rains in conjunction with ice dams. Less frequently, flooding occurs later in the year as a result of localized thunderstorms or hurricanes. The largest of these floods occurred in March 1896, March 1936, March 1977, January 1978, March 1983, April 1987, July 1934, March 1936, and April 1987. No estimate of peak flow was available for the 1896 flood, but the 1936, 1977, and 1987 flows were estimated at 5,490, 5,000, and 7,500 cfs, respectively.

Low-lying areas are subject to periodic flooding caused by overflows of the Lamprey River, Exeter River, and Squamscott River. The most severe flooding occurs in early spring as a result of snow melt and heavy rains. In the past, portions of Prescott Road along Lamprey River have flooded nearly every year. The 1989 replacement of the Prescott Road Bridge over the Lamprey River should help alleviate this condition. During the April 1987 flood, up to two feet of water covered portions of Harriman Hill Road. Old Manchester Road and Main Street were also affected by flooding of the Lamprey River in 1987.

The low-lying areas along the Atlantic coast are subject to the periodic flooding and wave attack that accompany northeasters and hurricanes. The majority of these storms cause damage only to low coastal roads, boats, and seawalls. Occasionally, a major storm accompanied by strong onshore winds and high tides results in surge and wave activity that cause extensive property damage and erosion. Some of the more significant storms include those of December 1909, December 1959, February 1972, and February 1978. The recurrence intervals for these storms were 160 years, 15 years, 10 years, and 70 years, respectively. Other significant storms occurred in the vicinity of North Hampton in November 1945, November 1963, November 1968, and November 1969. These storms damaged harbors, marinas, and commercial and residential developments along the flood-prone coastline (FEMA, City of Portsmouth, 1981).

During spring runoff periods, the Exeter River frequently flooded roads on the south side of the Town of Exeter, including Court Street, Crawford Avenue, and Portsmouth Avenue. A USGS surface-water discharge station was active on the Exeter River at the Haigh Road Bridge in Brentwood during a 1996 storm and recorded a peak discharge of 3,060 cfs. This event had a recurrence interval of approximately 100 years. Additional areas were flooded by the Exeter River, due to rainfall associated with hurricanes in 1938 and 1954. The area on the north side of the Exeter River in Tib's Grove is subject to occasional backwater flooding from Phillips dam in the Town of Brentwood.

The major portion of the Spicket River floodplain lies between the Arlington Mill Reservoir and the Massachusetts State line. Because of its flat gradient and the numerous swamps and lakes in the watershed, peak flows and stages on the Spicket River are a function of high-volume rainfall.

The middle reach of Policy Brook between Rockingham Park Boulevard and Pleasant Street is subject to periodic flooding due to its flat gradient and the many restrictions caused by inadequately sized pipes and culverts.

The Squamscott River periodically floods the Swasey Parkway and other low-lying areas during unusually high tides. In the past, within the Town of Greenland, little significant damage has occurred in these areas, however, due to the general absence of buildings and other structures.

Low-lying areas adjacent to Great Bay are subject to periodic flooding. Little significant damage occurs in these areas, however, due to the general absence of buildings and other structures.

Areas along Pickering Brook are subject to flooding. Present damage potential is slight due to absence of structures in affected marshes. However, future flood damage could be significant if development upstream of State Route 151 is allowed to lower the road elevation of 31 feet. This road crest is the emergency spillway necessary if debris clogs the only culvert through the dam-like road fill. The extensive upstream beaver action and by-products of urbanization could be sources of flood-creating debris.

Extensive flooding in the low-lying areas surrounding the Powwow Pond system occurred in March 1983. During the flood, elevations on Great Pond peaked at approximately 2 feet above the dam crest. According to records at the New Hampshire Department of Water Resources, this is the maximum recorded elevation for Great Pond.

Minor damage to Cuba Road frequently occurs due to flooding of the Piscassic River. This flooding usually occurs during March and April during spring rains and snowmelt. Floods occurring during other seasons are often associated with debris clogging culverts. Due to the natural and manmade hydraulic structures along the Piscassic River, and the number of beavers in the watershed, collection of debris generally compounds flooding.

Flooding problems have occurred in the past and may be expected to occur in the future at the undersized culvert at State Route 125 crossing of Kelly Brook. Such situations can create backwaters of depth sufficient to inundate extensive areas of land.

2.4 Flood Protection Measures

The State of New Hampshire provides concrete seawalls and stone revetments to protect coastal highways. The USACE built shoreline protection structures at Wallis Sands State Beach (U.S. Department of the Interior, 1962) and at Hampton

Beach (New England River Basins Commission, 1980). The Town of Rye maintains a small portion of the waterfront barrier in the southern end of town. Other protective coastal structures were constructed and are maintained by the local municipalities and private property owners to satisfy their individual requirements and financial capabilities. These structures include such backshore protection as timber and steel sheetpiles, bulkheads, stone revetments, concrete seawalls, and pre-cast concrete units (U.S. Army Corps of Engineers, 1971). Limited financial resources sometimes result in less than adequate protection.

A breakwater located in the Town of Rye that is maintained by the USACE provides some protection for Little Harbor. There are some small-scale protective structures maintained by private homeowners that satisfy individual requirements.

A protective breakwater is located on the north shore of the Hampton Harbor inlet. It extends approximately 1,000 feet southeast into the Atlantic Ocean and protects the mouth of both Hampton and Seabrook Harbors from wave action.

The Water Division of the New Hampshire Department of Environmental Services controls the Trickling Falls Dam at the outlet of Powwow Pond and the dam at the outlet of Great Pond. During the fall and early winter, flash boards are removed from these dams and the ponds are lowered to provide extra storage capacity for spring runoff. There are also extensive low-lying areas surrounding the Powwow Pond system. These areas provide natural storage that serves to reduce flood peaks.

Dams at the outlet of Powwow Pond and Great Pond in East Kingston provide some flood protection in areas upstream of South Hampton; however, the effect on peak discharge in South Hampton is not significant (U.S. Department of the Interior, 1962). Likewise, the dam at Tuxbury Pond provides negligible flood protection.

In the Town of Stratham, zoning has been established to prevent development within 150 feet of the Squamscott River and 100 feet of major freshwater streams.

There is a levee separating sewage treatment plant stabilization lagoons from the Squamscott River. FEMA specifies that all levees must have a minimum of 3 feet freeboard against 100-year flooding to be considered a safe flood protection structure. The levee has a nominal crest elevation of 14 feet, yielding a 6-foot freeboard which meets FEMA freeboard requirements. There are also several small dams within the town. However, they do not significantly alter flood flows.

The numerous swampy areas and small ponds within Rockingham County provide natural storage that serves to reduce flood peaks.

Newmarket has no existing or proposed flood control structures. During extreme flood events, floodwaters from the Lamprey River overflow State Route 108 upstream in Durham and are diverted into the Oyster River basin. These overflows or diversions reduce peak flood discharges of the Lamprey River before it reaches the Town of Newmarket. During a 100-year flood, diversions to the Oyster River basin reduce flood peaks in Newmarket by approximately 20 percent (FEMA, 1991).

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the county, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this FIS. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1-percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the county at the time of completion of this FIS. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for the flooding sources studied in detail affecting the county.

For each community within Rockingham County that has a previously printed FIS report, the hydrologic analyses described in those reports have been compiled and are summarized below.

Precountywide Analyses - Riverine

Discharge-frequency data for the flooding sources studied by detailed methods were determined from equations based on multiple-regression analyses of data from USGS gaged sites in New Hampshire and adjacent areas of bordering states (U.S. Department of the Interior, 1978). The equations contain the independent variables basin drainage area, main-channel slope, and a precipitation intensity index.

No stream gages have been operated in the Powwow River Basin. To calculate the 100-year frequency flood discharges, three separate reports were consulted (U.S. Department of the Interior, 1975; U.S. Department of the Interior, 1978; and U.S. Department of the Interior, 1983). The three reports document techniques that can be used to estimate flood peaks on rural basins in Maine, New Hampshire, and Massachusetts. In each of the reports, regression equations were used to relate flood-peak discharges to basin characteristics such as drainage area, stream slope, basin storage, and precipitation. The Powwow River basin is located near coastal New Hampshire in an area close to both Massachusetts and Maine. Data from this portion of New Hampshire was included in each of three studies and as a result, information from all of the reports could be appropriate for use.

Flood discharges were computed using equations from each of the three reports and the results were carefully reviewed. Analysis indicated that use of the equation documented in the report for Massachusetts would be most appropriate (U.S. Department of the Interior, 1983). The Massachusetts report is the most current of the three and it used a larger data base. Most importantly, the area studied in the report was divided into three separate regions and regression equations were calculated for each. One of the three zones was the eastern or coastal area, the region in which the Powwow River basin is located. Regression equations developed for the eastern region were specific to the coastal type of watershed. The Massachusetts equations have also been used in two other studies in the Powwow River basin: East Kingston, New Hampshire, and Amesbury, Massachusetts (FEMA, April 1986; FEMA, 1982).

Due to the excessive amount of natural storage in the Powwow Pond system, adjustment of the peak discharge was required. Using techniques documented in a USGS report, a basin lag time and an inflow hydrograph were computed with a peak discharge of 1,240 cfs (U.S. Department of the Interior, 1983). The resultant hydrograph was routed through the Powwow Pond system using the Modified Puls Method (Linsley, R. K., et al., 1982). The Modified Puls method is based on a form of the continuity equation in which for any time period, average inflow less average outflow equals change in storage within the system. Based on this analysis, the resultant 100-year frequency outflow from Powwow Pond is 850 cfs. Drainage area ratios were used to compute 100-year frequency peak discharges at alternate points in the Powwow Pond system as a function of the outflow from Powwow Pond.

Due to the absence of gaged data, the principal source of data for defining discharge-frequency relationships for all detailed streams in Windham (Beaver Brook, Golden Brook, Flatrock Brook, and Hidden Valley Brook) was regional discharge-frequency equations developed by Manuel Benson. These regional equations relate topographical and precipitation characteristics to streamflow (U.S. Department of the Interior, 1962).

The Squamscott River, Exeter River, Little River No. 1, Little River No. 2, and Winnicut River are ungaged. The 10-, 50-, and 100-year discharges were based on regional peak discharge and frequency formulas developed by the USGS (U.S. Department of the Interior, 1978). A separate evaluation of these formulas was performed and found to be applicable to the Exeter region. In addition, the formulas were expanded and an equation was developed to predict the 500-year discharge. The USGS formulas predict discharges based on the parameters of watershed drainage area, main channel slope, and rainfall intensity.

Hydrologic analysis of the 100-year flood was performed for Dudley Brook. Discharge for the 100-year flood was based on a U.S. Water Resources Council log-Pearson Type III frequency analysis of gage data at the USGS gage no. 01073600 on Dudley Brook near the Town of Exeter, which has 23 years of record (1962 – 1985) and a drainage area of 12.1 square miles (U.S. Water Resources Council, 1976). Discharges from the gage analysis were transferred to stream stations removed from the gage by the formula:

$$Q / Qg = (A/Ag)^{0.75}$$

Where Q is the discharge at the different specific site locations, Qg is the discharge at the USGS stream gage, and A and Ag are the drainage areas at the specific site and at the USGS stream gage, respectively.

Discharges for the Little River No. 3, Kelly Brook, and Bryant Brook were developed by combining the results of regional flood frequency equations with discharge values transposed from gaged basins in the region, which are similar in size and characteristics, to those studied. The regional equations, developed from regression analysis of gaging records for eastern Massachusetts using basin parameters to estimate flood peaks, were applied at several points along each stream (U.S. Geological Survey, 1977). USGS gage no. 0107300 on the Oyster River in Durham was used to transpose discharges to the Little River No. 3. This gage has a period of record of 43 years and a drainage area of 12.1 square miles. The USGS gage no. 01073600 on Dudley Brook near Exeter was used to transpose discharges to Kelly Brook and Bryant Brook. The transposition was carried out using the formula as shown above.

The principal sources of data for defining discharge-frequency relationships for detailed study streams in Londonderry (Beaver Brook, Black Brook, Cohas Brook, Little Cohas Brook, Nesenkeag Brook, Shields Brook, Tributary C to Beaver Brook, Tributary E to Little Cohas Brook, Tributary H to Nesenkeag Brook, Tributary J to Black Brook, Tributary O to Beaver Brook, and Upper Beaver Brook) were the regional equations developed by Manuel Benson of the USGS. These regional equations relate topographical and precipitation characteristics to streamflow (U.S. Department of the Interior, 1962).

Discharges for Hidden Valley Brook were derived by comparing values predicted by regional equations and discharge-frequency relationships based on a log-Pearson Type III analysis (U.S. Water Resources Council, 1976) for the gages in the vicinity on Stony Brook (USGS Gage No. 093800) and on Dudley Brook (USGS Gage No. 073600) (U.S. Department of the Interior, 1976).

Discharge-frequency data for Hog Hill Brook, Wash Pond Tributary, Hill Brook, Wash Pond, and Shop Pond were determined from equations based on multiple-regression analyses of data from USGS gaged sites in New Hampshire and adjacent areas bordering states (U.S. Department of the Interior, 1978). The equations contain the independent variable basin drainage area, main-channel slope, and a precipitation intensity index.

Discharge values for the Exeter River in the Town of Brentwood were obtained from the previous FISs for the Towns of Brentwood and Exeter (FEMA, 1980; FEMA, May 1982). Peak discharges for the Exeter River were obtained from the Town of Exeter FIS, enacted on November 17, 1981, and were based on regional peak discharge and frequency formulas developed by the USGS and expanded to predict the 500-year discharge (U.S. Department of the Interior, 1978). Peak discharges for the Exeter River obtained from the original FIS for the Town of

Brentwood were based on a flow rate per unit area relationship with a USGS surface-water discharge station on the Lamprey River (FEMA, 1981).

For the Exeter River in the Town of Raymond, only the peak 100-year return period discharge was computed. The peak discharge at the Blueberry Hill Road bridge was available from NHDOT (U.S. Department of the Interior, 1962). The value was computed using regionally developed peak flows for more frequent storms in combination with a methodology involving a probability distribution to produce the 100-year peak discharge. The peak 100-year discharge computed by Rivers Engineering Corporation using methodology used as part of the FISs for other New Hampshire communities was not significantly different from the value computed by the NHDOT (U.S. Water Resources Council, 1977). The NHDOT value was adjusted to other location on the Exeter River based on the ratio of the drainage areas.

Gaging stations on the Lamprey River, located approximately 9 miles north of the Exeter River, and on Dudley Brook, a tributary of the Exeter River, were the principal sources of data for determining discharge-frequency relationships for the Exeter River in the Town of Fremont. The gages have been in operation since 1934 and 1962, respectively. Values for the 10-, 50-, 100-, and 500-year peak discharges were obtained from a log-Pearson Type III distribution of annual peak flow data.

Flows for the various frequencies were transformed to a flow rate per unit area and plotted versus drainage area on log-log paper. A straight line was drawn through the pairs of flow-drainage area coordinates computed for the gages. Flows for drainage areas of the Exeter River at various locations in Fremont were taken from the plot.

A check on the procedure described above was made at the Fremont-Brentwood corporate limits by application of regional relationships developed in USGS Water-Supply Paper 1580-B and Water Resources Investigations 78-47 (U.S. Department of the Interior, 1962; U.S. Department of the Interior, 1978). The regression analyses developed in these reports relate peak discharge to drainage area, channel slope and rainfall intensity. The method in Water-Supply Paper 1580-B also considers indices for surface water area, January temperature, and orographic effect.

Since the Piscassic River is ungaged, discharge-frequency data for this flooding source was developed using the USGS Water Resources Investigation Report, WRI 78-47, a synthetic runoff procedure that relies on regionalized climatological data coupled with the individual stream physical characteristics for input (U.S. Department of the Interior, 1978).

For Beaver Brook, Cunningham Brook, Drew Brook, Taylor Brook, Tributary E to Beaver Lake, Tributary F to Beaver Lake, Tributary G to Beaver Lake, Tributary H to Drew Brook, and Tributary O to Beaver Brook, the principal source of data for defining discharge-frequency relationships was the regional discharge-frequency equations developed by the USGS (U.S. Department of the Interior, 1962). These regional equations relate topographical and precipitation characteristics to streamflow. Due to the extensive upstream channel and pond storage and flatter slopes, discharges for the Hornes Brook-Shields Brook watershed were derived using a regional discharge-frequency equation based on streams with similar characteristics (U.S. Department of the Interior, 1974).

Discharges for Beaver Brook were modified due to the storage effects of Beaver Lake. Golden Brook was modified due to the storage effects of Cobbetts Pond and Moeckel (Simpson)-Rock Ponds. Taylor Brook was modified due to the storage effects of Ballard Pond. A reservoir routing using a numerical iteration method (Viessman, Warren J., et al., 1972) was performed on Beaver Lake and Island Pond. The results of this routing were used to adjust the discharges of Beaver Brook and Taylor Brook and to establish the water-surface elevations of Beaver Lake for the 10-, 50-, 100-, and 500-year floods. The results of the reservoir routing performed on Cobbetts Pond were used in conjunction with the results of Benson's equation to adjust the discharges of Golden Brook between Tributary C and Moeckel (Simpson)-Pond. Below Moeckel (Simpson) Pond, the discharges were adjusted using the results of the reservoir routing performed on Moeckel (Simpson)-Rock Ponds.

The principal source of data for defining the discharge-frequency relationships for the Lamprey River was the USGS gaging station located in Durham, which had been operating since 1934. Values of the 10-, 50-, 100-, and 500-year peak discharges were obtained from a log-Pearson Type III distribution of annual peak flow data (U.S. Department of the Interior, 1967).

Discharge-frequency estimates for areas above the stream gage were developed using a regional relationship developed in a USGS report (U.S. Department of Agriculture, 1979). The regression analysis developed in this report relates peak discharge to drainage area, channel slope, rainfall intensity, surface storage, January temperature, and orographic influences. The flow estimates developed by the USGS were estimated by multiplying the ratio of discharge based on gage data to that based on the USGS method for the gaged area time the discharge developed by the USGS at locations within Raymond.

Flood flows for the Lamprey River were determined by using regional equations for peak discharges applicable to the area (Southeastern New Hampshire Regional Planning Commission, 1974). This method combines basin and climatic characteristics through specific regression equations to yield discharges for the 10-, 50-, and 100-year floods. Peak discharges for the 500-year return period storm were based on an equation developed as an extension of the methodology developed by the USGS and used for prediction of the peak 500-year return period discharge as part of the FISs for other New Hampshire communities (U.S. Water Resources Council, 1977; Southeastern New Hampshire Regional Planning Commission, 1974). Peak flows computed by use of the regional equations were determined to be more appropriate for the Lamprey River in Raymond than a transposition of peak flows computed at the gaging station downstream in Durham. As described below, the transposition of flows from the gage produced peak flows in Raymond that did not adequately reflect the magnitude of flooding experienced by the community.
There are no continuous records of discharges on the Spicket River. A peak discharge for the March 1968 flood was computed and reported by the USGS for the Spicket River at a dam located approximately 1.5 miles below the Salem, New

Hampshire-Methuen, Massachusetts, town line. A peak discharge of 1,440 cubic feet per second (cfs) was computed at this site, which has a total drainage area of 73.8 square miles.

A gaged stream in the region with similar hydrologic characteristics is the Parker River, located approximately 15 miles southeast of Salem. This river has 30 years of discharge records for a contributing watershed of 21.6 square miles. Discharge frequencies for the Spicket River were estimated using peak discharge frequency data for the Parker River. Frequencies for the Parker River were developed from historical flow data using the log-Pearson Type III statistical distribution (U.S. Water Resources Council, 1976, Bulletin 15). The frequencies for the Spicket River were then developed by multiplying the Parker River flows by the ratio of the known 1968 peak discharges on both streams. Discharges at other locations along the Spicket River were derived by multiplying the adopted discharges at the dam in Methuen by a factor equal to the ratio of the drainage areas to the 0.7 exponential power.

Over the years, Policy Brook has been modified by the installation of two long conduits under and adjacent to Rockingham Park. Conduit A extends from just upstream of Pleasant Street to just above the brook's second crossing of the Boston and Maine Railroad and State Route 28. It passes under the horse barn area of the race track. Conduit B and an excavated section of open ditch run along the railroad and bypass the second railroad/State Route 28 crossing. This bypass was installed to reduce the flooding of a mobile home park just to the east of State Route 28.

The installation of the bypass results in Policy Brook having two channels, an East Channel and a West Channel in this area. The West Channel (conduit-ditch) carries all of the flows from upper Policy Brook during non-flood periods as the second railroad/State Route 28 crossing has been partially blocked.

Flood discharges for the lower reaches of Policy Brook, its East Channel, and Unnamed Brook were developed by estimating the mean annual peak flows based on an appraisal of existing culvert size on the streams and the sluggish hydrologic character of the watersheds. Rarer flood flows for the brooks were determined as multiples of the mean annual flows by use of the "Bigwood-Thomas" type flood formula as well as by rainfall frequency comparisons (U.S. Geological Survey, 1955). Both the Technical Release No. 20 (TR-20) and the Technical Release No. 55 (TR-55) models were used to develop the 100-year flood discharges at various points in the watershed (U.S. Department of Agriculture, 1992; U.S. Department of Agriculture, 1986). TR-20 is a synthetic rainfall runoff procedure that relies on regionalized climatological data coupled with the individual stream physical characteristics for input (U.S. Department of Agriculture, 1983). Drainage areas, land uses and times of concentration were computed using USGS quadrangle coverage. A rainfall of 6.5 inches in a 24-hour period was used to produce the unit hydrographs.

The peak discharge for the April 1987 flood at the USGS gage at Packers Falls was 7,500 cfs. The 100-year flood discharge at the gage was determined in Section 3.1 to be 7,300 cfs. The 1987 flood was therefore slightly greater than the 100-year flood. Peak flood elevations that occurred during the 1987 flood were identified and surveyed in the field by the study contractor. The 100-year profile for Lamprey was based on these elevations and data available for Durham (FEMA, 1991).

A TR-55 analysis was used to develop discharges on Porcupine Brook and Porcupine Brook Tributary.

For the analysis of the West Channel and the upper reaches of Policy Brook, temporary flood storage in Canobie Lake, in the large, flat area between Pleasant Street and South Policy Road and in Rockingham Park at the outlet of Conduit A were included in the TR-20 model. The area above Pleasant Street, because of its size and the limited capacity of Conduit A, is especially effective in reducing flood flows.

Since Pickering Brook is not gaged, discharge-frequency data for this stream were developed using TR-20.

For World End Pond, both the outlet channel and the constricted downstream road crossings (Lawrence Road and Farm Road) were modeled. For the 100-year flood, the road crossings were found to control the upstream water levels and these stage discharge relationships were used in the TR-20 model.

Only the 100-year flood elevations have been determined for stillwater elevations for Wash Pond, Country Pond, Great Pond, Piscataqua River, World End Pond, and Shop Pond. No adjustments to computed "Stillwater Elevations" were made to account for changes in storage in Wash Pond and Shop Pond. These changes in storage were considered insignificant.

Discharges for approximate study streams were also developed using Manuel Benson's regional discharge-frequency equations (U.S. Department of the Interior, 1962).

Precountywide Analyses - Coastal

In New England, flooding of low-lying coastal sections is caused primarily by storm surges generated by extratropical coastal storms called northeasters. Hurricanes also occasionally produce significant storm surges in New England, but they occur infrequently compared to northeasters.

Analyses were carried out to establish the peak tidal elevation-frequency relationships for floods of the selected recurrence intervals for coastal flooding on the Piscataqua River at Portsmouth. Flood levels at the mouth of the Piscataqua River were then propagated upstream through the Great Bay Estuary System to the headwaters of the Squamscott River.

Significant flooding of the Squamscott River is caused by storm tides from Great Bay, which are primarily a result of extratropical northeastern storms and hurricanes. Thus, peak tidal elevation-frequency relationships were first determined at the mouth of the Piscataqua River. Study data were obtained for peak tidal elevation-frequency relationships for coastal flooding on the Piscataqua River at Portsmouth. Peak tidal elevation-frequency relationships for the Atlantic Ocean in Portsmouth were determined through a statistical analysis of the total tide elevation produced by historical northeasters and hurricanes.

The study for the Squamscott River and the Atlantic Ocean was based on a statistical analysis of the total tide elevations produced by historical northeasters and hurricanes.

The National Ocean Survey (NOS) tide gage on Seavey Island provided limited data on which to base the analysis. In order to provide a longer data base, a statistical technique called regionalization was used to generate synthetic, peak total elevations for years prior to the establishment of tide gages at Portsmouth, Boston, and Portland, Maine, and for the time periods when data was incomplete (Massachusetts Institute of Technology, 1977).

Regionalization is a process by which an onsite historical data series of limited duration can be lengthened through the use of regional data (Massachusetts Institute of Technology, 1977). The NOS tide gages at Boston, Massachusetts, and Portland, Maine, were used to statistically lengthen the Portsmouth data base. By cross-correlating peak, total tide elevations for many storms for which data were available at all three stations, a statistical relationship was developed between the gages. This relationship was then used to synthesize a peak, total tide elevation at Portsmouth for the years prior to the establishment of the gage. These correlated values were then added to actual readings from the Portsmouth gage to produce a lengthened data base. Analyzing the synthetic data series increased the validity of the prediction of peak tidal elevation-frequency relationships.

Flood levels of significance in Great Bay are caused by storm tides on the coast at Portsmouth primarily caused by extratropical northeastern storms and hurricanes. Study data were obtained for peak tidal elevation-frequency relationships for coastal flooding on the Piscataqua River at Portsmouth (FEMA, 1982).

To calculate the storm surge and total stillwater elevations produced by historic storms, it was necessary to determine the storm pressure and wind fields. A computer model was developed by the study contractor to simulate these fields based on several, easily obtained, northeaster storm parameters. A detailed description of this model is presented in the report titled Development and Verification of a Synthetic Northeaster Model for Coastal Flood Analysis (Stone & Webster Engineering Corporation, 1978). A different model was used to simulate the wind and pressure fields of the hurricanes considered in this analysis (Stone & Webster Engineering Corporation, 1977). When coupled with a computer surge model, the storm tide along the shoreline could be calculated for each storm of interest.

Synoptic weather maps were searched to determine the northeasters and hurricanes that could potentially produce significant flooding in the North Hampton area. Tidal records from tide gages in the New England area were examined to verify which historic storms produced high-water elevations. A total of 165 storms, from 1942 to 1978, was considered in the analysis of flood levels.

The flood levels associated with historic storms were simulated using a modified version of the FEMA storm surge model (Tetra Tech, Inc., 1977; Stone & Webster Engineering Corporation, Determination of Coastal Storm Tide Levels, 1978). Input to the model consisted of wind and pressure fields and generated either by the synthetic northeaster model or a hurricane wind and pressure field model for each historic storm selected. The study area was modeled using a square grid of sufficient resolution to accurately represent the offshore bathymetry and shoreline configuration. The grid mesh covered an area from Cape Cod Bay to north of Portsmouth, New Hampshire, including Boston Harbor. Output from the model included the time history of storm-induced surge elevations in the study area. These elevations were combined with the predicted astronomical tide for the same time period to produce total stillwater elevations for the communities in the study area. The total stillwater elevation was calibrated using historic tide elevation data at Boston, Massachusetts, and Portsmouth, New Hampshire. Thus, the historic storm-induced flood levels could be simulated for each storm considered in the analysis.

The extent and frequency of recurrence of coastal flooding were determined by conducting a frequency analysis of annual maximum tidal heights along the coastline of Rockingham County. Some historic stillwater heights, consisting of an astronomical tide and a storm surge contribution, were determined by the mathematical simulation of historic northeasters and hurricanes as described above; others, for which associated storm data were not available, were obtained by a correlation analysis using tide data from Boston or Portsmouth. The data base at the Boston gage extended from 1978 discontinuously back to 1948; the shorter record at Portsmouth was lengthened by a statistical correlation with data at Boston and Portland. The annual maxima of these reproduced historic stillwater elevations were fitted with the Pearson Type III distribution. The goodness of fit was tested with the chi-square test and accepted at the 95-percent confidence level. A detailed description of the methodology employed in this analysis can be found in the report titled Determination of Coastal Storm Tide Levels (Stone & Webster Engineering Corporation, 1978).

The analyses reported in this study reflect the stillwater elevations due to tidal and wind setup effects. The effects of wave action are considered in the determination of flood hazard areas. Coastal structures that may be located above stillwater flood elevations can still be severely damaged by wave runup, wave-induced erosion, and wave-borne debris. For example, during the February 1978 northeaster, considerable damage along the New Hampshire coast was caused by wave activity, even though most of the damaged structures were above the high-water level. The extent of wave runup past stillwater levels depends greatly on the wave conditions and local topography.

For the Town of Rye, wave heights and corresponding wave crest elevations were determined using the National Academy of Sciences (NAS) methodology (National Academy of Sciences, 1977). The wave runup was determined using the methodology developed by Stone & Webster Engineering Corporation for FEMA (Stone & Webster Engineering Corporation, 1981).

A summary of the drainage area-peak discharge relationships for all of the streams studied by detailed methods is shown in Table 4, "Summary of Discharges." The drainage areas shown for the Powwow River and Grassy Brook were taken from a USGS report on hydrological characteristics of streams in the Merrimack River basin (U.S. Department of the Interior, 1984). For stream locations not available in the report, adjustments to published values were based on USGS topographic maps (U.S. Department of the Interior, 1985, et cetera; U.S. Department of the Interior, 1981).

TABLE 4 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs)			
		10-YEAR	50-YEAR	100-YEAR	500-YEAR
BEAVER BROOK					
At Pelham-Windham corporate limits	51.0	1,500	2,560	3,180	4,930
At Pelham-Windham-Hudson corporate limits	48.6	1,450	2,470	3,070	4,750
Downstream of Robinson Pond Brook	48.3	1,400	2,430	3,010	4,670
Upstream of Robinson Pond Brook	45.0	1,310	2,360	2,900	4,490
At Londonderry-Windham-Hudson corporate limits	44.2	1,200	2,120	2,800	4,150
At confluence with Black Brook	38.3	1,040	2,100	2,580	4,050
Upstream of Tributary C to Beaver Brook near Station 20.5	32.7	860	1,760	2,160	3,600
From upstream of Tributary C to Beaver Brook in Londonderry to downstream of Tributary O to Beaver Brook in Derry[1]	32.7[2]	800	1,660	2,050	3,500
From upstream of Tributary O to Beaver Brook to downstream of Hornes Brook[1]	24.3[2]	750	1,520	1,860	3,300

[1]Reach Discharge
[2]Drainage area at downstream limit of reach

TABLE 4 – SUMMARY OF DISCHARGES – continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
BEAVER BROOK (continued)					
At Londonderry-Windham-Derry corporate limits	27.0	720	1,510	1,860	3,300
From upstream of Hornes Brook to downstream of Tributary G to Beaver Brook[1]	17.5[2]	400	1,150	1,440	2,880
At Londonderry-Derry corporate limits	26.3	720	1,510	1,860	3,300
From upstream of Tributary G to Beaver Brook to downstream of Tributary B to Beaver Brook	12.5[2]	130	510	650	1,410
From upstream of Tributary B to Beaver Brook to 650 feet downstream of outlet of Beaver Lake[1]	12.0[2]	65	380	430	960
At outlet of Beaver Lake	11.2	32	240	320	730
BLACK BROOK					
At mouth	5.6	185	345	425	830
At Adams Road	2.0	20	60	90	290
BRYANT BROOK					
Downstream limit of detailed study	3.9	175	290	355	550
COHAS BROOK					
At Londonderry-Manchester corporate limits	12.3	410	760	990	1,550
CUNNINGHAM BROOK					
At confluence with Leavitt and Drew Brooks	3.4	245	630	775	1,540
At confluence with Tributary H to Nesenkeag Brook	2.0	145	390	480	1,000
At Hampstead Road	1.1	75	215	260	560

[1]Reach Discharge
[2]Drainage area at downstream limit of reach

TABLE 4 – SUMMARY OF DISCHARGES – continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
DUDLEY BROOK					
At eastern corporate limits of town of Brentwood	6.1	*	*	589	*
At USGS gaging station 01073600	5.0	*	*	506	*
DREW BROOK					
From Island Pond to confluence of Leavitt and Cunningham Brooks[1]	5.0[2]	115	285	350	700
EXETER RIVER					
Downstream of the confluence of Little River No. 1	114.6	2,811	4,107	4,827	6,518
Upstream of the confluence of Little River No. 1	100.8	2,453	3,589	4,219	5,704
Upstream of confluence of Great Brook	89.9	2,173	3,183	3,741	5,064
At eastern corporate limits of the Town of Brentwood	73.0	1,990	2,880	3,280	4,230
At Haigh Road	64.0	1,810	2,640	3,010	3,900
At eastern corporate limits of the Town of Freemont	60.0	1,740	2,520	2,880	3,750
At downstream corporate limits of the Town of Raymond	49.6	*	*	2,700	*
At Blueberry Hill Road bridge	46.8	*	*	2,550	*
At upstream corporate limits of the Town of Raymond	37.1	*	*	2,020	*
FLATROCK BROOK					
At inlet to Shadow Lake	7.3	270	640	760	1,450
Downstream of tributary near Station 0.9	6.9	220	540	640	1,230
Upstream of tributary near Station 0.9	5.9	190	460	550	1,030
At outlet to Seavey Pond	5.3	170	420	495	960

[1]Reach Discharge
[2]Drainage area at downstream limit of reach
*Data not available

TABLE 4 – SUMMARY OF DISCHARGES – continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs)			
		10-YEAR	50-YEAR	100-YEAR	500-YEAR
GOLDEN BROOK					
At outlet to Moeckel (Simpson)-Rock Ponds	11.5	100	550	750	1,490
At Inlet to Moeckel (Simpson)-Rock Ponds	10.5	340	805	960	1,700
At downstream confluence with Tributary B	5.9	273	665	791	1,400
At upstream confluence with Tributary B	3.1	142	369	439	860
At downstream confluence with Tributary A	2.4	103	273	325	630
GRASSY BROOK					
At confluence with Powwow River	1.67	*	*	198	*
HIDDEN VALLEY BROOK					
At confluence with Beaver Brook	2.5	150	270	325	540
At culvert near station 1.0	1.9	120	220	260	430
At Londonderry road culvert	1.1	75	135	165	275
HILL BROOK					
At State Route 111	1.52	*	*	120	*
HOG HILL BROOK					
At Haverhill Road	8.38	*	*	680	*
At Kathi Lane	5.52	*	*	410	*
At Island Pond Road in the town of Atkinson	4.75	*	*	380	*
HORNES BROOK					
From Beaver Brook to Hornes Pond[1]	6.82	260	313	368	500
KELLY BROOK					
Downstream limit of detailed study	4.9	285	405	495	735

[1]Reach Discharge
*Data not available

TABLE 4 – SUMMARY OF DISCHARGES – continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
LAMPREY RIVER					
At Durham-Newmarket corporate limits	188	*	*	6,000	*
At USGS Gage No. 01073500	183	*	*	7,300	*
At the northern corporate limits of Town of Epping	154	3,500	5,000	5,600	6,900
At State Route 101	112	2,960	4,370	4,930	6,270
At Blake Road	102	2,820	4,240	4,720	6,020
At the western corporate limits of Town of Epping	74	2,380	3,740	4,180	5,360
At the downstream corporate limits of Town of Raymond	74	2,760	4,330	5,290	7,470
At Langford Road	52	2,200	3,590	4,370	6,340
At Alternate State Route 101	33	1,600	2,710	3,300	4,880
LITTLE COHAS BROOK					
At Industrial Road	6.70	190	365	480	770
At Harvey Road	6.30	150	310	385	540
At Litchfield Road	1.00	70	135	170	275
LITTLE RIVER NO. 1					
At the confluence with the Exeter River	13.9	345	528	624	874
LITTLE RIVER NO. 2					
At Ocean Boulevard	4.67	118	189	226	330
LITTLE RIVER NO. 3					
Downstream limit of detailed study near Atkinson Depot Road	20.8	660	1,065	1,275	1,865
Upstream of Bryant Brook	17.1	560	900	1,075	1,585
Upstream of Seaver Brook	12.2	415	665	795	1,175
Upstream of Kelly Brook	7.0	255	405	485	715
Plaistow-Kingston corporate limits	4.2	175	280	335	495
NESENKEAG BROOK					
At Londonderry-Litchfield corporate limits	6.90	380	720	870	1,390
At confluence with Tributary H to Nesenkeag Brook	4.80	260	500	625	1,000

*Data not available

TABLE 4 – SUMMARY OF DISCHARGES – continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
PICKERING BROOK					
At Portsmouth Avenue (State Route 151)	2.45	39	48	53	62
At access road	0.80	*	*	86.54	*
PISCASSIC RIVER					
At Ice Pond	13.8	312	480	560	760
At Cuba Road	9.0	206	318	371	503
POLICY BROOK					
At Rockingham Park Inlet	5.9	350	550	660	880
At State Route 28	5.2	250	390	460	620
At a point approximately 2,000 feet above State Route 28	5.0	180	290	330	440
At a point approximately 700 feet below Main Street	4.8	100	190	210	260
UNNAMED BROOK					
At the State Route 97 bridge	0.7	70	100	120	170
PORCUPINE BROOK					
At Interstate Route 93	3.1	*	*	650	*
At Old Causeway	2.2	*	*	450	*
PORCUPINE BROOK TRIBUTARY					
At Quill Lane	0.8	*	*	210	*
POWWOW RIVER					
At Lake Gardiner Dam in Amesbury, Massachusetts	49.1	*	*	1,720	*
Downstream reach at corporate limits near Lake Gardiner	48.3	*	*	1,700	*
At Tuxbury Pond Dam in Amesbury, Massachusetts	45.9	*	*	1,640	*
Upstream reach at corporate limits in Tuxbury Pond	41.4	*	*	1,540	*

*Data not available

TABLE 4 – SUMMARY OF DISCHARGES – continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
SHIELDS BROOK					
From Hornes Pond to first crossing (looking upstream) of Derry-Londonderry corporate limits[1]	6.7[2]	260	313	368	500
At first Londonderry-Derry corporate limits (looking upstream)	5.2	190	465	575	1,000
From first crossing (looking upstream) of Derry-Londonderry corporate limits to second crossing (looking upstream) of Derry-Londonderry corporate limits	5.2[2]	146	234	276	362
At confluence of Upper Beaver Brook	4.6	160	405	500	880
At second Londonderry-Derry corporate limits (looking upstream)	2.2	75	200	250	450
From second crossing (looking upstream) of Derry-Londonderry corporate limits to upstream study limit[1]	2.22	84	127	146	200
SHOP POND					
At outlet	2.52	*	*	150	*
SPICKET RIVER					
At Hampshire Road	61.6	900	1,600	1,900	2,900
At Town Farm Road	47.9	800	1,300	1,600	2,400
At the confluence of Providence Hill Brook	40.0	700	1,200	1,400	2,100
At Arlington Mill Reservoir	26.8	350	650	750	1,100
TAYLOR BROOK					
At Island Pond	5.3	75	365	525	1,345
At outlet to Ballard Pond	4.6	10	200[3]	320[3]	960[3]
At inlet to Ballard Pond	3.4	320	820	1,005	2,000
At confluence with Tributary J to Beaver Brook	2.5	210	560	690	1,400

[1]Reach Discharge
[2] Drainage Area at Downstream Limit of Reach
[3]Discharges reduced due to Ballard Pond Storage
*Data not available

TABLE 4 – SUMMARY OF DISCHARGES – continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
THE POWWOW POND SYSTEM					
At Powwow Pond/ Powwow River Outlet	29.6	*	*	850	*
At Country Pond outlet	14.2	*	*	410	*
At Great Pond outlet	9.96	*	*	290	*
TRIBUTARY C TO BEAVER BROOK					
At mouth	2.8	185	365	450	740
At Chester Road	2.3	120	235	310	490
TRIBUTARY D					
At Londonderry-Derry corporate limits	1.5	70	200	245	520
TRIBUTARY E TO BEAVER LAKE					
At mouth	2.8	190	350	435	700
At Chester Road	1.6	125	235	290	470
TRIBUTARY E TO LITTLE COHAS BROOK					
At Beaver Lake	1.4	110	310	385	820
At Tsienneto Road	1.3	105	295	365	760
TRIBUTARY F TO BEAVER LAKE					
At Beaver Lake	7.2	250	590	725	1,350
At outlet to Adams Pond	6.0	195	475	585	1,150
TRIBUTARY G TO BEAVER BROOK					
At confluence with Beaver Brook	3.6	245	625	770	1,500
Downstream of confluence with West Running Brook	3.5	210	540	660	1,290
Upstream of confluence with West Running Brook	2.1	180	495	610	1,250
At Windham Road	1.3	120	335	410	900
TRIBUTARY H TO DREW LAKE					
At mouth	2.5	155	310	390	640

*Data not available

TABLE 4 – SUMMARY OF DISCHARGES – continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
TRIBUTARY H TO NESENKEAG BROOK					
At confluence with Drew Brook	1.4	110	305	375	795
Approximately 1,000 feet upstream of Hampstead Road	1.0	25	40	120	150
TRIBUTARY J TO BLACK BROOK					
At mouth	1.6	110	140	180	285
TRIBUTARY O TO BEAVER BROOK					
At confluence with Beaver Brook	1.7	75	205	255	535
At Derry-Londonderry corporate limits	1.5	70	200	245	520
UPPER BEAVER BROOK					
At mouth	2.0	65	160	215	430
WASH POND					
At outlet	2.42	*	*	150	*
WASH POND TRIBUTARY					
At confluence with Wash Pond	1.03	*	*	62	*
At Kent Farm Road	0.9	*	*	54	*
WEST CHANNEL POLICY BROOK					
At Pleasant Street	2.8	*	*	200	*
At Pelham Road	2.5	*	*	380	*
WINNICUT RIVER					
At the downstream corporate limits of town of North Hampton	5.97	113	168	198	275

*Data not available

The stillwater elevations for the 100-year flood have been determined for all detailed studied ponds and tidal areas and are summarized in Table 5, "Summary of Stillwater Elevations." For a description of the methodologies used to compute these elevations, please refer to Section 3.2, Hydraulic Analyses, in this text.

TABLE 5 - SUMMARY OF STILLWATER ELEVATIONS

FLOODING SOURCE AND LOCATION	ELEVATION (feet NGVD[1]) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
ADAMS POND				
At Derry	326.0	327.1	327.3	328.1
ATLANTIC OCEAN				
Entire shoreline within North Hampton and Rye	8.3	8.9	9.2	9.8
Entire shoreline within Hampton, Hampton Falls, New Castle, Seabrook, and Seabrook Beach	8.2	8.9	9.2	9.8
Entire shoreline within Portsmouth	8.0	8.6	8.9	9.5
BEAVER LAKE				
At Derry	287.9	289.3	289.6	294.0
COUNTRY POND				
Entire shoreline with Kingston	*	*	120.8	*
GREAT BAY				
Entire shoreline of the Squamscott River within the Exeter corporate limits to a point approximately 370 feet downstream of Chestnut Hill Avenue	7.1	7.6	7.9	8.4
Entire shoreline within Greenland, and Newington, and the entire shoreline of Great Bay and Lamprey River downstream of from MacCallen Dam in Newmarket	6.4	7.0	7.2	7.8
Entire shoreline of the Squamscott River within Newfield, and the entire shoreline within Stratham	6.9	7.5	7.7	8.2
GREAT POND				
Entire shoreline within Kingston	*	*	121.8	*
ISLAND POND				
At the Towns of Derry and and Atkinson's corporate limits, in Derry, and the entire shoreline within Hampstead	205.5	206.4	206.8	208.2

[1]National Geodetic Vertical Datum of 1929
*Data Not Available

TABLE 5 - SUMMARY OF STILLWATER ELEVATIONS - continued

FLOODING SOURCE AND LOCATION	ELEVATION (feet NGVD[1]) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
LOWER BALLARD POND				
At Derry	251.5	253.6	254.6	256.2
LOWER BEAVER LAKE				
At Derry	287.9	288.9	289.2	290.0
PISCATAQUA RIVER				
At Newington	*	*	9.0	*
POWWOW POND/ POWWOW RIVER				
Upstream of New Boston Road	*	*	120.8	*
Upstream of Boston & Maine Railroad bridge	*	*	119.1	*
Downstream of Boston & Maine Railroad bridge	*	*	118.2	*
SEAVEY POND				
At Windham	*	*	248.6	*
SHOP POND				
Entire shoreline with Hampstead	*	*	232.4	*
SQUAMSCOTT RIVER				
Entire length within Stratham	6.9	7.5	7.7	8.2
TUXBURY POND				
Entire shoreline	*	*	100.2	*
UPPER BALLARD POND				
At Derry	253.7	255.5	258.4	259.2
WASH POND				
Entire shoreline within Hampstead	*	*	234.8	*
WORLD END BROOK AND POND				
At Lawrence Road in Salem	*	*	117.0	*

[1]National Geodetic Vertical Datum of 1929
*Data Not Available

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the source studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data tables in the FIS report. For construction and/or floodplain management purposes, users are encouraged to use the flood elevation data presented in this FIS in conjunction with the data shown on the FIRM.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the FIRM (Exhibit 2).

All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry.

Flood profiles were drawn showing the computed water-surface elevations for floods of the selected recurrence intervals.

The hydraulic analyses for this FIS were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

For each community within Rockingham County that has a previously printed FIS report, the hydraulic analyses described in those reports have been compiled and are summarized below.

Precountywide Analyses - Riverine

Cross sections and geometry of hydraulic structures were obtained from field surveys conducted during the 1990 field season by the study contractor. Cross-section extensions were based on information contained on USGS topographic maps (U.S. Department of the Interior, 1985, et cetera; U.S. Department of the Interior, 1981).

For the Town of Raymond FIS report dated April 15, 1992, cross sections for the Exeter and Lamprey Rivers were obtained from field surveys and interpolation from USGS topographic maps (U.S. Department of the Interior, September 1981). Elevation data and structural geometry for bridges and culverts on both rivers were obtained from a combination of record drawings and field survey. The Prescott Road bridge at the downstream end of the Lamprey River in the Town of Raymond was under construction at the time the revised hydraulic analyses were performed. For this reason, drawings issued for construction were used to obtain hydraulic data for this bridge.

The portions of the cross sections contains within the limits of the channel were obtained by field survey by Kenneth A. LeClair Associates (Kenneth A. LeClair Associates, 1978). Overbank cross-sectional data were read from topographic maps at a scale of 1:2,400 (State of New Hampshire, 1970). Bridge plans were utilized to obtain elevation data and structural geometry for bridges over the streams studied in detail. Where plans were unavailable or out-of-date, bridges were also surveyed.

Cross sections for the backwater analyses of the detailed study streams were located at close intervals above and below bridges in order to compute the significant backwater effects of these structures in the developed areas. In long reaches between structures, appropriate valley cross sections were also surveyed.

For Hog Hill Brook, cross sections and geometry of hydraulic structures were obtained from field surveys conducted during the 1988 field season by the USGS. Cross-section extensions and basin characteristics were based on information contained on USGS topographic maps at a scale of 1:25,000 and 1:24,000 with contour intervals of 3 meters and 10 feet (U.S. Department of the Interior, 1985, et cetera). For Island Pond and Bryant Brook, cross sections for the backwater analyses were located at close intervals above and below bridges in order to compute the significant backwater effects of these structures in developed areas. In long reaches between structures, appropriate valley cross sections were also surveyed.

Cross-section data for the Spicket River were taken from a USACE floodplain report (U.S. Army Corps of Engineers, 1975). For Policy Brook and Unnamed Brook, cross-section data were obtained by field survey.

For the Powwow Pond/Powwow River, cross sections and elevations and structural geometry of hydraulic structures were obtained from field surveys conducted by the study contractor during the 1987 field season. Upper-end extensions of cross sections and storage areas were based on information contained on USGS topographic maps (U.S. Department of the Interior, 1981).

Water-surface elevations of floods of the selected recurrence intervals were computed using the WSPRO step-backwater computer program (Federal Highway Administration, 1990; U.S. Department of the Interior, 1989).

Water-surface elevations of floods of the selected recurrence intervals for Beaver Brook, Exeter River, Little River No. 1, Shields Brook, Hornes Brook, Taylor Brook, Drew Brook, Cunningham Brook, Tributary O to Beaver Brook, Tributary E to Beaver Lake, Tributary F to Beaver Lake, Tributary G to Beaver Brook, and Tributary H to Nesenkeag Brook were developed using the USACE HEC-2 step-backwater computer program (U.S. Army Corps of Engineers, 1973; U.S. Army Corps of Engineers, 1977). Elevation data and structural geometry for bridges and culverts on both rivers were obtained from a combination of record drawings and field survey. The Prescott Road bridge at the downstream end of the Lamprey River in the Town of Raymond was under construction at the time the revised hydraulic analyses were performed. For this reason, drawings issued for construction were used to obtain hydraulic data for this bridge. Water-surface elevations for Spicket

River of floods of the selected recurrence intervals were computed using the USACE HEC-2 step-backwater computer program (U.S. Army Corps of Engineers, 1976).

Water-surface elevations of floods of the selected recurrence intervals were computed for all detailed study streams in the community through use of the USACE HEC-2 step-backwater computer program (U.S. Army Corps of Engineers, 1977).

Water-surface elevations of floods of the selected recurrence intervals for Hog Hill Brook, Pickering Brook, the Lamprey River, Piscassic River, West Channel Policy Brook, Porcupine Brook, and portions of the Exeter River in Fremont were computed using the SCS WSP-2 step-backwater computer program (U.S. Department of Agriculture, 1979; U.S. Department of Agriculture, 1976; U.S. Department of Agriculture, 1993).

The 100-year elevations for Hog Hill Brook were computed by applying WSPRO step-backwater computer model (Federal Highway Administration, 1986; Federal Highway Administration, 1990). Starting water-surface elevations for the 100-year flood discharge on Hog Hill at the downstream side of Haverhill Road bridge at the Salem-Atkinson corporate limits were determined using the slope/area method (Federal Highway Administration, 1986; Federal Highway Administration, 1990). Starting water-surface elevations for Bryant Brook were determined by the slope/area method. Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals.

Starting water-surface elevations for Hog Hill Brook were based on computations of elevation versus discharge at Wadleigh Falls in the Town of Lee.

Starting water-surface elevations for the Lamprey River were taken from the lower reaches of the river in the FIS report dated May 2, 1995 (FEMA, 1995). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals.

The starting water-surface elevation for the downstream reach of the Powwow River was determined by rating the dam at the outlet of Lake Gardiner in Amesbury, Massachusetts using the weir equations referenced above. The starting water-surface elevation for Grassy Brook was computed by a slope conveyance calculation (Federal Highway Administration, 1986; U.S. Department of the Interior, 1989). The stream slope was determined from field surveys.

Starting water-surface elevations for the Exeter River in the Town of Raymond, Winnicut River, Little River No. 3, Kelly Brook, and Bryant Brook were determined by the slope/area method. Water-surface elevations of floods of the selected recurrence intervals were computed for the Little River, Kelly Branch, and Bryant Brook in the study area through use of the USACE HEC-2 step-backwater computer program (U.S. Army Corps of Engineers, 1976).

Starting water-surface elevations for the Exeter River in the Town of Exeter and Little River No. 2 were determined using critical depth. Starting water-surface elevations for the Exeter River in the Town of Fremont were based on computations of elevation versus discharge at Phillips Dam and for the Exeter River in the Town of Brentwood, starting water-surface elevations were taken from a previously studied downstream portion of the river (FEMA, October 15, 1980, FIS report; and April 15, 1981, FIRM).

Starting water-surface elevations for the Little River No. 1 were determined using normal pool elevation for the Exeter River in the Town of Exeter for the 10-year flood and the slope/area method for the 50-, 100-, and 500-year floods.

Starting water-surface elevations for the 100-year flood discharges on Hill Brook at the downstream side of the State Route 111 bridge and Shop Pond Outlet at the downstream side of Mills Shore Drive were computed using the slope-conveyance method (Federal Highway Administration, 1986 and 1990). The starting water-surface elevation for the 100-year flood discharge on Wash Pond Tributary was the 100-year flood elevation for Wash Pond.

For Golden Brook and Hidden Valley Brook, starting water-surface elevations were determined through normal depth analysis. For Flatrock Brook, the starting water-surface elevation was determined from a rating curve developed at the outlet of Shadow Lake.

Starting water-surface elevations for Beaver Brook were obtained from the Londonderry FIS and Hudson FIS (U.S. Department of Housing and Urban Development, 1978); Shields Brook and Tributary D from the Derry FIS (U.S. Department of Housing and Urban Development, unpublished); and Nesenkeag Brook from the Litchfield FIS (U.S. Department of Housing and Urban Development, 1977). For Black Brook, Tributary E to Beaver Lake, Tributary J to Black Brook, Tributary C to Beaver Brook, Upper Beaver Brook, Cohas Brook, Tributary H to Drew Brook, Dudley Brook, Island Pond, and Shields Brook studied by detailed methods, starting water-surface elevations were determined by normal-depth analyses.

Starting water-surface elevations for Tributary E to Little Cohas Brook and Tributary F to Beaver Lake were obtained from the Beaver Lake flood elevations, and starting water-surface elevations for Drew Brook and Taylor Brook were obtained from Island Pond flood elevations. Starting water-surface elevations for Tributary H to Nesenkeag Brook were obtained from the Drew Brook flood profile because these streams have concurrent flood peaks.

Starting water-surface elevations for the Spicket River at the dam at Arlington Mills Reservoir were determined from the standard Weir Formula $Q=CLH^{3/2}$. At the southern corporate limit, the 100-year flood elevation was taken from the USACE floodplain report (U.S. Army Corps of Engineers, 1975). The starting water-surface elevation for the 10-, 50-, and 500-year floods exceeded the capacity of the 60-inch culvert, and it was assumed that the water level of 124 feet (also top of the culvert) would be the ponding level for all frequency events.

Starting water-surface elevations for West Channel Policy Brook and Porcupine Brook were taken from the 1978 FIS for the Town of Salem, and a Master Drainage Study done by Weston & Sampson Engineers, Inc., respectively (U.S. Department of Housing and Urban Development, Federal Insurance Administration, 1978; Weston and Sampson Engineers, Inc., 1988). A rating curve for World End Pond was computed by backwater analysis of flows through the Lawrence Road-Farm Road culverts.

The starting water-surface elevations for the Piscassic River were determined by computing critical depths at the Piscassic Ice Pond Dam.

Pickering Brook was studied by detailed methods in the Town of Greenland FIS, dated May 17, 1989, from a point 2,400 feet upstream of its confluence with Great Bay extending up to the corporate limits for the Town of Greenland. Starting water-surface elevations for Pickering Brook were determined by assuming critical depth at the upstream normal high tide limits of Great Bay. Water-surface elevations of floods of the selected recurrence intervals were computed through the use of the SCS WSP2 step-backwater computer program. Pickering Brook was also studied by detailed methods using the HEC-RAS hydraulic model by a LOMR effective October 6, 1999, in the Town of Portsmouth, New Hampshire, from a point approximately 2,482 feet upstream of the corporate limits for the City of Portsmouth to a point approximately 2,733 feet upstream of the corporate limits. The hydraulic analysis for Pickering Brook was extended downstream of the LOMR effective October 1999, using the HEC-RAS hydraulic model, to the corporate limits of the City of Portsmouth. The starting water-surface elevations were set at the 100-year water-surface elevation at the corporate limits for the Town of Greenland.

Elevations of MacCallen Dam and the State Route 108 bridge in Newmarket were obtained from field surveys conducted by the study contractor. The 100-year flood elevations for the Lamprey River upstream from MacCallen Dam were based upon high-water elevation data available for the April 1987 flood and data available from the FIS for the Town of Durham (FEMA, 1991).

The 100-year flood elevation for Tuxbury Pond was determined by rating the dam at the outlet of the pond. The rating curve for the dam was determined by applying the appropriate flow over weir equations documented in a USGS publication (U.S. Department of the Interior, 1967). This elevation was also used as the starting water-surface elevation for the upstream reach of the Powwow River.

The valley portions of the cross-section data for all detailed study streams were obtained photogrammetrically by James W. Sewall Company (James W. Sewall Company, 1977); the below-water portions were obtained by field measurement by Thomas F. Moran, Inc. (Thomas F. Moran, Inc., 1977). Bridge plans were utilized to obtain elevation data and structural geometry. All bridges for which plans were unavailable or out of date were surveyed.

In those areas where the analysis indicated supercritical flow conditions, critical depth was assumed for the flood elevation because of the inherent instability of supercritical flow.

Approximate methodologies for Hidden Valley Brook include hydrologic and hydraulic calculations based on the detailed study and field investigation.

Along certain portions of Piscassic River, a profile base line is shown on the maps to represent channel distances as indicated on the flood profiles and floodway data tables.

The 100-year flood for portions of both the Spicket River and Policy Brook were approximated, using information from an SCS Flood Prone Area Map (U.S. Department of Agriculture, 1974).

The 100-year flood on several smaller streams were approximated using the FHBM for the Town of Salem as a guide (U.S. Department of Housing and Urban Development, 1977).

The 100-year flood elevation for Powwow Pond/Powwow River downstream from the Boston and Maine Railroad bridge was determined by rating the dam (Trickling Falls Dam) at the outlet of the pond. For the purposes of this analysis, it was assumed that a total of 1 foot of stop logs in the gates of the dam have been removed, a practice commonly used by the Water Division of the New Hampshire Department of Environmental Services. The rating curve for the dam was determined by applying appropriate flow over weir equations documented in a USGS publication (U.S. Department of the Interior, 1967).

The 100-year flood elevation for Powwow Pond/Powwow River upstream from the Boston and Maine Railroad bridge is controlled by the dam at the outlet of the pond and the constriction caused by the bridge opening. The flood elevation was determined by treating the opening as a culvert and passing the 100-year discharge through it by applying appropriate formulas contained in a USGS publication (U.S. Department of the Interior, 1968).

The 100-year flood elevation for Powwow Pond/Powwow River upstream from New Boston Road is influenced by the constriction caused by the twin culverts at the crossing. The flood elevation was determined by passing the 100-year flood discharge through the twin culverts by applying appropriate formulas contained in a USGS publication (U.S. Department of the Interior, 1968). Road overflow at the site was computed by applying a step-backwater computer model (Federal Highway Administration, 1986).

The 100-year elevation for Country Pond is the same as determined for Powwow Pond/Powwow River upstream from New Boston Road. Backwater from the culverts at New Boston Road extends into Country Pond. The bridge at the outlet of Country Pond does not constrict the flow sufficiently to increase elevations in the pond. To verify this fact, a step-backwater run was made through the reach (Federal Highway Administration, 1986).

The 100-year elevation for Great Pond is influenced by backwater caused by the culvert under State Route 125 and Main Street bridge just downstream from the outlet. The dam at the outlet of the lake has only a small head and is drowned out during floods. Elevations upstream from State Route 125 were determined by passing the 100-year flood discharge through the culvert by applying appropriate formulas contained in a USGS publication (U.S. Department of the Interior, 1968). The elevation upstream from State Route 125 and the 100-year flood discharge were routed through the bridge opening of the State Route 111 crossing and into the pond using a step-backwater model (Federal Highway Administration, 1986).

Roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and were based on field observations of the streams and floodplain areas. Roughness factors for all streams studied by detailed methods are shown in Table 6, "Manning's "n" Values."

TABLE 6 - MANNING'S "n" VALUES

Stream	Channel "n"	Overbank "n"
Beaver Brook	0.020-0.055	0.040-0.100
Black Brook	0.020-0.055	0.040-0.100
Bryant Brook	0.035-0.040	0.060-0.090
Cohas Brook	0.020-0.055	0.040-0.100
Cunningham Brook	0.035-0.055	0.065-1.000
Drew Brook	0.035-0.055	0.065-1.000
Dudley Brook	0.035-0.080	0.035-0.130
Exeter River	0.020-0.080	0.020-0.150
Flatrock Brook	0.030-0.040	0.050-0.080
Golden Brook	0.022-0.045	0.060-0.080
Grassy Brook	0.030-0.040	0.140
Hidden Valley Brook	0.025-0.045	0.045-0.090
Hill Brook	0.040-0.055	0.035-0.110
Hog Hill Brook	0.035-0.065	0.075-0.100
Hornes Brook	0.035-0.055	0.065-1.000
Island Pond	0.035-0.055	0.065-1.000
Kelly Brook	0.030-0.040	0.050-0.090
Lamprey River	0.030-0.100	0.040-0.120
Little Cohas Brook	0.020-0.055	0.040-0.100
Little River No. 1	0.020-0.070	0.050-0.100
Little River No. 2	0.013-0.040	0.100
Little River No. 3	0.030-0.060	0.030-0.100
Nesenkeag brook	0.020-0.055	0.040-0.100
Pickering Brook	0.040-0.120	0.070-0.120
Piscassic River	0.025-0.070	0.060-0.180
Policy Brook – Unnamed Brook	0.020-0.060	0.100
Porcupine Brook	0.020-0.060	0.100
Porcupine Brook Tributary	0.020-0.060	0.100
Powwow Pond System	0.025-0.035	0.030-0.090
Powow River	0.030-0.040	0.035-0.140
Shields Brook	0.020-0.055	0.040-1.000
Spicket River	0.035	0.080
Taylor Brook (Including Ballard Pond)	0.035-0.055	0.065-1.000

TABLE 6 - MANNING'S "n" VALUES - continued

Stream	Channel "n"	Overbank "n"
Tributary C to Beaver Brook	0.020-0.055	0.040-0.100
Tributary E to Beaver Lake	0.020-0.055	0.040-0.100
Tributary E to Little Cohas Brook	0.035-0.055	0.065-1.000
Tributary F to Beaver Lake	0.035-0.055	0.065-1.000
Tributary G to Beaver Brook	0.035-0.055	0.065-1.000
Tributary H to Drew Brook	0.020-0.055	0.040-0.100
Tributary H to Nesenkeag Brook	0.035-0.055	0.065-1.000
Tributary J to Black Brook	0.020-0.055	0.040-0.100
Tributary O to Beaver Brook	0.035-0.055	0.065-1.000
Upper Beaver Brook	0.020-0.055	0.040-0.100
Wash Pond Tributary	0.035-0.055	0.030-0.100
West Channel Policy Brook	0.020-0.060	0.100
Winnicut River	0.020-0.050	0.070
World End Brook and Pond	0.020-0.060	0.100

No Manning's "n" factors were assigned for computations on Catletts Creek since its flood hazard is dependent upon valley restrictions with their associated storage and not upon conveyance.

Precountywide Analyses - Coastal

Areas of coastline subject to significant wave attack are referred to as coastal high hazard zones. The USACE has established the 3-foot breaking wave as the criterion for identifying the limit of coastal high hazard zones (U.S. Army Corps of Engineers, June 1975; U.S. Army Corps of Engineers, 1973). The 3-foot wave has been determined as the minimum size wave capable of causing major damage to conventional wood frame or brick veneer structures.

Wave height analyses were performed to determine wave heights and corresponding wave crest elevations for the areas inundated by the tidal flooding. A wave runup analysis was performed to determine the height and extent of runup beyond the limit of tidal inundation. The results of these analyses were combined into a wave envelope, which was constructed by extending the maximum wave runup elevation seaward to its intersection with the wave crest profile.

The methodology for analyzing wave heights and corresponding wave crest elevations was developed by the NAS (National Academy of Sciences, 1977). The NAS methodology is based on three major concepts.

First, a storm surge on the open coast is accompanied by waves. The maximum height of these waves is related to the depth of water by the following equation:

$$H_b = 0.78d$$

where H_b is the crest to trough height of the maximum or breaking wave and d is the stillwater depth. The elevation of the crest of an unimpeded wave is determined using the equation:

$$z_w = S_* + 0.7H_* + 0.55d$$

where z_w is the wave crest elevation, S_* is the stillwater elevation at the site, and H_* is the wave height at the site. The 0.7 coefficient is the portion of the wave height which reaches above the stillwater elevation. H_b is the upper limit for H_*.

The second major concept is that the breaking wave height may be diminished by dissipation of energy by natural or man-made obstructions. The wave height transmitted past a given obstruction is determined by the following equation:

$$H_t = BH_i$$

where H_t is the transmitted wave height, H_i is the incident wave height, and B is a transmission coefficient ranging from 0.0 to 1.0. The coefficient is a function of the physical characteristics of the obstruction. Equations have been developed by the NAS to determine B for vegetation, buildings, natural barriers such as dunes, and man-made barriers such as breakwaters and seawalls (National Academy of Sciences, 1977).

The third concept deals with unimpeded reaches between obstructions. New wave generation can result from wind action. This added energy is related to distance and mean depth over the unimpeded reach.

The methodology for analyzing wave runup was developed by Stone and Webster Engineering Corporation (Stone and Webster Engineering Corporation, 1981). The wave runup computer program operates using an ensemble of deepwater wave heights, H_i, the stillwater elevation, S^*, a wave period, T_s, and beach slope, m. For Rockingham County, wave heights range from 3 feet up to the significant wave height of 30 feet; the wave period ranges from 7 to 14 seconds.

These concepts and equations were used to compute wave envelope elevations associated with the 100-year storm surge. Accurate topographic, land-use, and land-cover data are required for the coastal analyses. Maps of the study area, at a scale of 1:2,400 with a contour interval of 5 feet, were used for the topographic data (Avis Airmap, Inc., 1977). The land-use and land-cover data were obtained by field surveys.

Wave heights and wave runup were computed along transects which were located perpendicular to the average mean shoreline. The transects were located with consideration given to the physical and cultural characteristics of the land so that they would closely represent conditions in their locality. Transects were spaced close together in areas of complex topography and dense development. In areas having more uniform characteristics, the transects were spaced at larger intervals. It was also necessary to locate transects in areas where unique flooding existed and in areas where computed wave heights varied significantly between adjacent transects. Figure 1, "Transect Location Map," illustrates the location of the transects for the community.

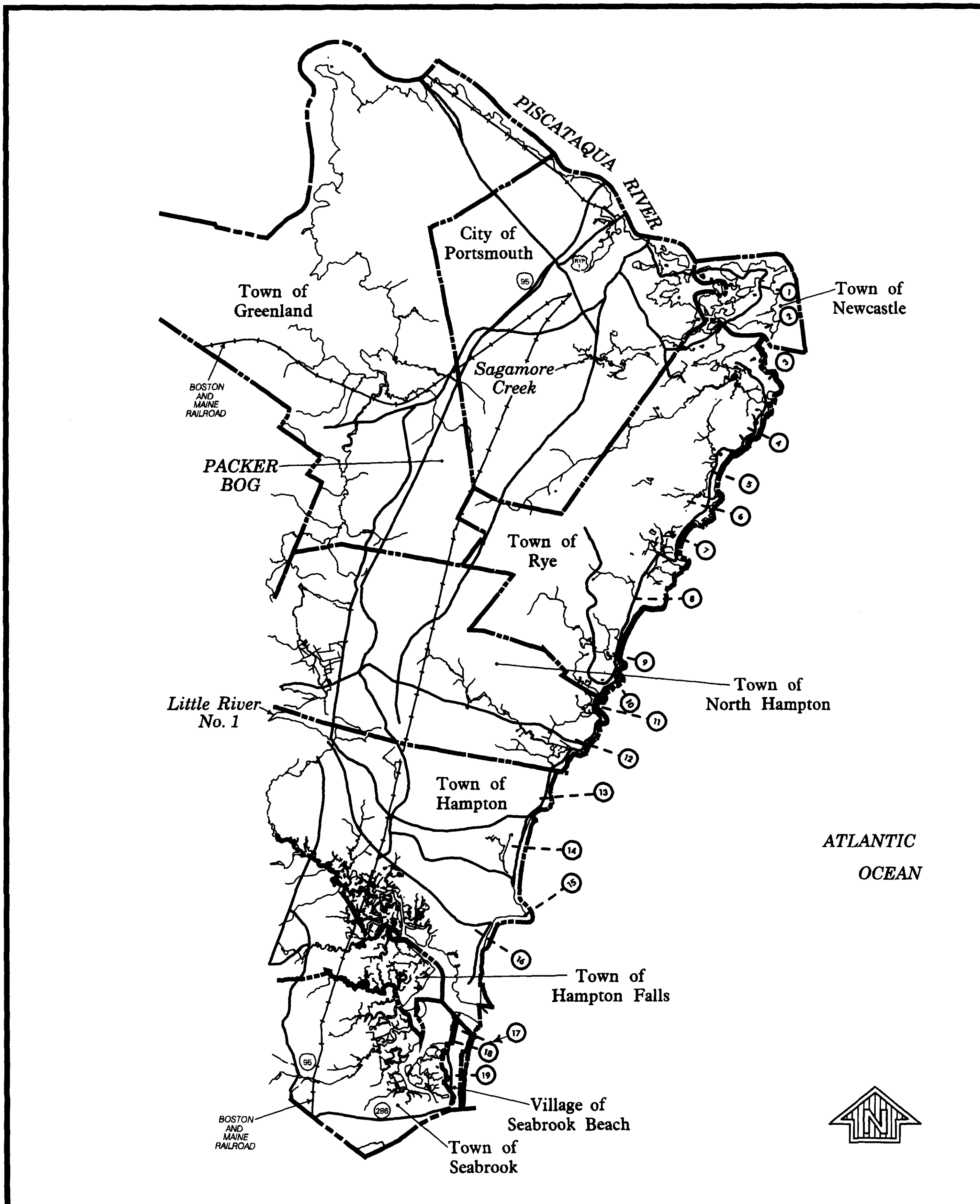


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH

(ALL JURISDICTIONS)

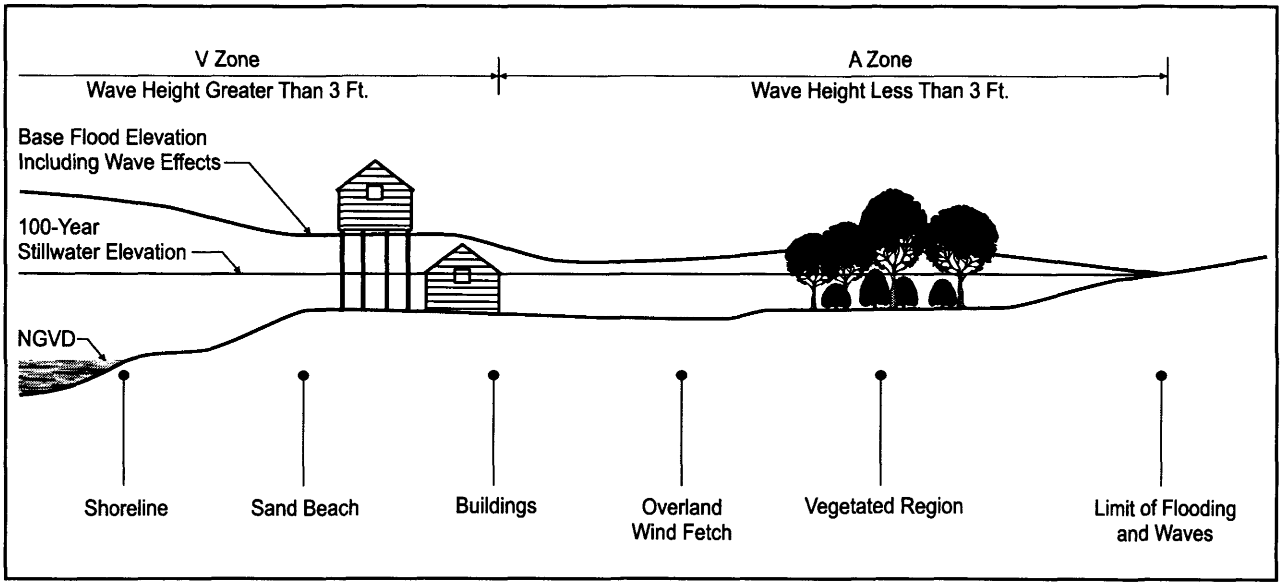
APPROXIMATE SCALE

1.5 0 1.5 3 4.5 MILES

TRANSECT LOCATION MAP

Along each transect, wave envelope elevations were computed considering the combined effects of changes in ground elevation, vegetation, and physical features. Between transects, elevations were interpolated using the topographic maps, land-use and land-cover data, and engineering judgment to determine the areal extent of flooding. The results of the calculations are accurate until local topography, vegetation, or cultural development within the community undergo any major changes.

Figure 2, "Transect Schematic," represents a sample transect, which illustrates the relationship between the stillwater elevation, the wave crest elevation, the ground elevation profile, and the location of the A/V zone boundary.



TRANSECT SCHEMATIC Figure 2

In some locations, water levels shown on the maps were computed by correlating synthetically produced water levels with elevations obtained during historic floods (U.S. Department of the Interior, 1979). Historic flood damage information was also used to ensure reasonable delineation of flood-prone areas along the Rockingham County shoreline.

The 10-, 50-, 100-, and 500-year coastal flood elevations presented for the Town of Hampton Falls and City of Portsmouth are stillwater elevations. The effects of wave action are not considered in the determination of flood hazard areas. Consequently, coastal structures that are located above stillwater flood elevations can still be severely damaged by wave runup, wave-induced erosion, and wave-borne debris. For example, during the northeasters of January and February 1978, considerable damage along the New Hampshire coast was caused by wave activity even though most of the damaged structures were above the still-highwater level.

Since the coastline of Hampton Falls and the City of Portsmouth is protected from heavy wave action, flood damage by wave action was not considered.

Areas of shallow flooding have been determined for the lee side of the dunes and seawalls along the Atlantic Ocean. In these areas, the wave runup elevation exceeded the highest elevation of the obstruction. The difference between the runup elevation and the dune crest or seawall was used to determine the depth of shallow flooding behind the dune or seawall.

Hydraulic analyses of the inland propagation of the coastal storm surge were performed for the Piscataqua River, Great Bay, and the Squamscott River estuary system using the 1-D Model. The 1-D Model is based on the hydrodynamic equations of motion and conservation of mass. The estuary system was divided into grids, with each cross section divided into areas of conveyance and storage. Cross-section data were obtained from U.S. Coast and Geodetic Survey nautical charts. The most downstream grid was located at the mouth of the Piscataqua River, while the most upstream grid was located just below the Chestnut Hill Avenue bridge over the Squamscott River in Exeter. A Chezy friction coefficient of 70 was used throughout the estuary. Wind effects were not included. Both upstream and downstream boundary conditions, the former being the function of freshwater inflow and the latter the sum of the astronomical tide and surge components, were specified initially and for the duration of the storm. Sensitivity analyses were performed for selected storm and hydraulic parameters.

Table 7, "Transect Data," shows the maximum and minimum VE and AE zone elevations at each coastal transect, as well as the 100-year stillwater elevations for the Atlantic Ocean.

TABLE 7 – TRANSECT DATA

FLOODING SOURCE	STILLWATER ELEVATION (feet NGVD 29) 10-YEAR	STILLWATER ELEVATION (feet NGVD 29) 100-YEAR	ZONE	BASE FLOOD ELEVATION[1] (feet NGVD 29)
ATLANTIC OCEAN				
Transects 1-2	8.2	9.2	VE	11-18
			AE	9-13
Transects 3-10	8.3	9.2	VE	12-22
			AE	9-12
			AO	1'-2' (Depth)
Transects 11-12	8.3	9.2	VE	14-23
			AE	9
			AO	1' (Depth)
Transects 13-14	8.2	9.2	VE	12-14
			AE	9

[1]Because of map scale limitations, base flood elevations shown on the FIRM represent average elevations for the zones depicted

All qualifying bench marks within a given jurisdiction that are cataloged by the National Geodetic Survey (NGS) and entered into the National Spatial Reference System (NSRS) as First or Second Order Vertical and have a vertical stability classification of A, B, or C are shown and labeled on the FIRM with their 6-character NSRS Permanent Identifier.

Bench marks cataloged by the NGS and entered into the NSRS vary widely in vertical stability classification. NSRS vertical stability classifications are as follows:

- Stability A: Monuments of the most reliable nature, expected to hold position/elevation well (e.g., mounted in bedrock)
- Stability B: Monuments which generally hold their position/elevation well (e.g., concrete bridge abutment)
- Stability C: Monuments which may be affected by surface ground movements (e.g., concrete monument below frost line)
- Stability D: Mark of questionable or unknown vertical stability (e.g., concrete monument above frost line, or steel witness post)

In addition to NSRS bench marks, the FIRM may also show vertical control monuments established by a local jurisdiction; these monuments will be shown on the FIRM with the appropriate designations. Local monuments will only be placed on the FIRM if the community has requested that they be included, and if the monuments meet the aforementioned NSRS inclusion criteria.

To obtain current elevation, description, and/or location information for bench marks shown on the FIRM for this jurisdiction, please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their Web site at www.ngs.noaa.gov.

It is important to note that temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook associated with this FIS and FIRM. Interested individuals may contact FEMA to access this data.

3.3 Vertical Datum

All FISs and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum in use for newly created or revised FISs and FIRMs was NGVD 29. With the finalization of the North American Vertical Datum of 1988 (NAVD 88), many FIS reports and FIRMs are being prepared using NAVD 88 as the referenced vertical datum.

All flood elevations shown in this FIS report and on the FIRM are referenced to NGVD 29. Structure and ground elevations in the community must, therefore, be referenced to NGVD 29. It is important to note that adjacent communities may be referenced to NAVD 88. This may result in differences in base flood elevations across the corporate limits between the communities.

For more information on NAVD 88, see Converting the National Flood Insurance Program to the North American Vertical Datum of 1988, FEMA Publication FIA-20/June 1992, or contact the Vertical Network Branch, National Geodetic Survey, Coast and Geodetic Survey, National Oceanic and Atmospheric Administration, Rockville, Maryland 20910 (Internet address http://www.ngs.noaa.gov).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. To assist in this endeavor, each FIS provides 100-year floodplain data, which may include a combination of the following: 10-, 50-, 100-, and 500-year flood elevations; delineations of the 100-year and 500-year floodplains; and 100-year floodway. This information is presented on the FIRM and in many components of the FIS, including Flood Profiles, Floodway Data tables, and Summary of Stillwater Elevation tables. Users should reference the data presented in the FIS as well as additional information that may be available at the local community map repository before making flood elevation and/or floodplain boundary determinations.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the county. For the streams studied in detail, the 100- and 500-year floodplain boundaries have been delineated using the flood elevations determined at each cross section.

Between the cross sections, the boundaries were interpolated using topographic maps (State of New Hampshire, 1970; USGS, 1956, 1966, 1973, 1974, 1977, 1981, 1985; James W. Sewall Company, 1976, 1977, 1978, 1979; Southeastern New Hampshire Regional Planning Commission, New Hampshire, August 1974; Avis Airmap, 1977; Southeastern New Hampshire Regional Planning Commission, Concord, New Hampshire, July 1975; and Underwood Engineers) and soil survey maps (U.S. Department of Agriculture, 1980, 1981, 1983, and 1986).

For the streams studied by approximate methods, the 100-year floodplain boundaries were delineated using a combination of the following: previously printed Flood Hazard Boundary Maps (U.S. Department of Housing and Urban Development, 1974, 1975, 1976, 1977; FEMA, 1986); previously printed FISs (FEMA, 1981 and 1988); topographic maps (USGS, 1953, 1956, 1966, 1968, 1973, 1974, and 1981; James W. Sewall Company, 1976, 1977, 1979; S.N.H.R.P.C., 1975, 1976); SCS Flood Prone Area Map (U.S. Department of Agriculture, 1974); and soil survey map (U.S. Department of Agriculture, 1983).

For tidal areas without wave action, the 100-year and 500-year boundaries were delineated using topographic maps (James W. Sewall Company, 1978 and 1979; Avis Airmap, Inc., 1977). For the tidal areas with wave action, the flood boundaries were delineated using the elevations determined at each transect; between transects, the boundaries were interpolated using engineering judgment, land-cover data, and the topographic maps referenced above. The 100-year floodplain was divided into whole-foot elevation zones based on average wave envelope elevation in that zone. Where the map scale did not permit these zones to be delineated at one-foot intervals, larger increments were used.

The 100- and 500-year floodplain boundaries are shown on the FIRM (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE), and the 500-year floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 100-year floodplain boundary is shown on the FIRM (Exhibit 2).

100-year flood data elevations are shown in Table 8, "100-Year Flood Data."

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this FIS are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this FIS were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (Table 9). The computed floodways are shown on the FIRM (Exhibit 2). In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

FLOODING SOURCE		RIVER CHANNEL				1% ANNUAL CHANCE WATER-SURFACE ELEVATIONS (FEET NGVD)
CROSS SECTION	DISTANCE[1] (FEET)	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	STREAM-BED ELEVATION (FT. NGVD)	
Hog Hill Brook						
A	20	125	603	1.1	127.2	137.4
B	1,540	140	682	1.0	128.0	137.9
C	1,600	180	713	1.0	129.4	138.0
D	2,580	50	93	7.3	140.7	143.6
E	2,650	126	761	0.9	142.5	154.3
F	2,800	147	531	1.3	145.6	154.3
G	2,850	200	220	3.1	149.1	154.3
H	4,000	73	125	3.3	149.8	154.5
I	4,390	30	54	7.6	161.1	164.4
J	4,460	214	436	0.9	164.1	168.6
K	5,400	57	84	4.9	168.6	172.0
L	6,100	67	148	2.8	174.7	178.5
M	7,820	147	355	1.2	176.2	181.5
N	8,910	289	553	0.7	178.3	181.8
O	8,980	95	421	0.9	180.3	188.5

[1]Distance in feet above Town of Atkinson corporate limits

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH (ALL JURISDICTIONS)

100-YEAR FLOOD DATA

HOG HILL BROOK

TABLE 8

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Beaver Brook								
A	13.926	135/25[2]	707	4.3	152.0	152.0	152.5	0.5
B	13.947	50/30[2]	415	7.4	154.7	154.7	154.7	0.0
C	14.037	85/65[2]	553	5.6	156.5	156.5	157.5	1.0
D	14.738	85/55[2]	573	5.4	163.5	163.5	164.1	0.6
E	14.942	180/120[2]	1,423	2.2	166.9	166.9	167.0	0.1
F	15.646	210/20[2]	1,266	2.4	167.8	167.8	168.8	1.0
G	15.990	50/20[2]	463	6.3	172.6	172.6	172.6	0.0
H	16.417	165/25[2]	1,105	2.6	175.4	175.4	175.9	0.5
I	17.057	160	663	4.2	176.7	176.7	177.7	1.0
J	17.964	50	327	8.2	192.1	192.1	193.1	1.0
K	18.993	110	821	3.3	209.1	209.1	209.1	0.0
L	20.017	50	444	6.1	210.0	210.0	211.0	1.0
M	20.482	90	634	4.2	213.5	213.5	214.2	0.7
N	21.305	80	617	3.3	219.2	219.2	220.2	1.0
O	21.799	195	560	3.7	219.9	219.9	220.6	0.7
P	22.802	260	1,565	1.3	226.0	226.0	227.0	1.0
Q	23.392	40	341	6.0	230.9	230.9	230.9	0.0
R	23.816	300	1,344	1.5	231.8	231.8	232.7	0.9
S	24.233	110	606	3.4	235.9	235.9	236.5	0.6
T	24.694	180	910	2.3	238.0	238.0	238.9	0.9
U	25.075	100	654	2.2	241.2	241.2	241.3	0.1
V	25.546	100	598	2.4	242.7	242.7	243.4	0.7
W	25.789	127	962	1.5	244.4	244.4	245.1	0.7
X	26.233	230	2,276	0.6	248.0	248.0	248.9	0.9
Y	26.648	300	2,677	0.2	248.0	248.0	248.9	0.9
Z	26.870	350	1,801	0.2	248.0	248.0	248.9	0.9

[1]Miles above confluence with Merrimack River
[2]Width/width within county boundary

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH (ALL JURISDICTIONS)

FLOODWAY DATA

BEAVER BROOK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Beaver Brook (continued)								
AA	27.244[1]	80	437	1.0	248.1	248.1	248.9	0.8
AB	27.580[1]	24	55	7.8	253.6	253.6	253.8	0.2
AC	27.652[1]	32	112	3.8	263.7	263.7	263.9	0.2
AD	27.838[1]	30	59	7.3	282.0	282.0	282.1	0.1
Black Brook								
A	0.400[2]	115	288	0.9	214.0	212.0[4]	212.8	0.8
B	1.000[2]	30	90	2.9	216.4	216.4	216.8	0.4
C	1.545[2]	20	43	6.2	257.2	257.2	257.2	0.0
D	1.737[2]	20	19	4.7	264.5	264.5	264.5	0.0
E	2.095[2]	30	17	5.3	281.5	281.5	281.5	0.0
F	2.369[2]	20	14	6.4	298.6	298.6	298.6	0.0
G	3.176[2]	25	23	3.9	321.0	321.0	321.0	0.0
Bryant Brook								
A	660[3]	27	59	6.0	47.8	47.8	48.8	1.0
B	1,370[3]	27	41	8.7	67.3	67.3	67.3	0.0
C	1,760[3]	15	37	9.6	73.3	73.3	73.7	0.4
D	2,815[3]	228	473	0.8	74.7	74.7	75.7	1.0
E	4,010[3]	96	193	1.8	76.3	76.3	77.3	1.0
F	5,955[3]	80	240	1.5	78.7	78.7	79.7	1.0
G	6,810[3]	238	395	0.9	79.3	79.3	80.3	1.0

[1]Miles above confluence with Merrimack River
[2]Miles above confluence with Beaver Brook
[3]Feet above confluence with Little River No. 3
[4]Elevation computed without consideration of backwater effects from Beaver Brook

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH
(ALL JURISDICTIONS)

FLOODWAY DATA

BEAVER BROOK – BLACK BROOK – BRYANT BROOK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Cohas Brook								
A	0.000[1]	30	155	6.3	227.3	227.3	228.3	1.0
B	0.312[1]	30	120	8.2	233.7	233.7	234.1	0.4
C	0.700[1]	50	202	4.9	245.0	245.0	246.0	1.0
D	1.032[1]	40	163	6.0	249.4	249.4	250.1	0.7
E	1.350[1]	80	348	2.8	259.7	259.7	260.4	0.7
Cunningham Brook								
A	0.155[2]	31	149	2.5	218.9	218.9	218.9	0.0
B	0.514[2]	24	55	6.7	251.6	251.6	252.1	0.5
C	1.040[2]	276	833	0.4	296.0	296.0	297.0	1.0
Drew Brook								
A	0.100[3]	170	974	0.4	206.8	206.8	207.8	1.0
B	0.425[3]	140	854	0.4	207.6	207.6	208.0	0.4
C	0.705[3]	65	376	0.9	208.9	208.9	208.9	0.0
D	1.043[3]	40	165	2.1	209.2	209.2	209.4	0.2
E	1.800[3]	70	129	2.7	213.8	213.8	214.0	0.2

[1] Miles above county boundary
[2] Miles above confluence with Drew Brook
[3] Miles above confluence with Island Pond

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH (ALL JURISDICTIONS)

FLOODWAY DATA

COHAS BROOK – CUNNINGHAM BROOK – DREW BROOK

TABLE 9

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Dudley Brook								
A	2,198	56	228	2.6	82.6	82.6	83.5	0.9
B	2,375	101	967	0.6	89.7	89.7	89.7	0.0
C	7,475	57	250	2.0	89.8	89.8	90.0	0.2
D	7,644	56	236	2.1	89.8	89.8	90.0	0.2
E	7,720	24	57	8.8	92.7	92.7	92.7	0.0
F	7,847	53	294	1.7	94.1	94.1	94.2	0.1
G	9,237	74	335	1.5	94.2	94.2	94.8	0.6
H	12,277	255	591	0.9	96.0	96.0	96.7	0.7
I	18,627	164	322	1.0	102.0	102.0	102.9	0.9
J	20,007	24	78	3.9	106.7	106.7	106.8	0.1
K	20,237	32	128	2.4	107.1	107.1	108.1	1.0
L	20,439	15	87	3.5	107.5	107.5	108.5	1.0
M	20,487	12	77	4.0	107.6	107.6	108.6	1.0

[1]Feet above Town of Brentwood corporate limits

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH (ALL JURISDICTIONS)

FLOODWAY DATA

DUDLEY BROOK

TABLE 9

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Exeter River								
A	0	213	416	11.6	11.8	11.8	11.8	0.0
B	175	120	647	7.5	13.8	13.8	13.8	0.0
C	325	93	965	5.0	22.0	22.0	22.1	0.1
D	395	135	1,920	2.5	30.4	30.4	30.5	0.1
E	598	70	938	5.1	31.1	31.1	31.1	0.0
F	2,338	119	1,634	3.0	31.7	31.7	32.2	0.5
G	2,451	99	1,656	2.9	31.7	31.7	32.2	0.5
H	3,681	549	4,257	1.0	31.7	31.7	32.5	0.8
I	6,421	820	5,696	0.7	32.0	32.0	32.9	0.9
J	9,381	639	5,632	0.7	32.4	32.4	33.4	1.0
K	15,881	956	7,956	0.5	32.7	32.7	33.7	1.0
L	19,231	1,218	6,205	0.6	32.9	32.9	33.9	1.0
M	23,829	142	1,500	2.5	33.5	33.5	34.5	1.0
N	23,940	73	860	4.3	34.6	34.6	34.8	0.2
O	25,140	196	1,992	1.9	35.3	35.3	36.1	0.8
P	26,280	351	2,433	1.5	35.6	35.6	36.6	1.0
Q	30,590	546	5,019	0.7	36.0	36.0	37.0	1.0
R	30,709	391	2,811	1.3	36.2	36.2	37.1	0.9
S	31,929	913	6,629	0.6	36.4	36.4	37.3	0.9
T	34,759	109	396	9.5	37.5	37.5	37.5	0.0
U	35,379	92	1,058	3.5	41.1	41.1	41.8	0.7
V	35,504	70	778	4.8	42.9	42.9	43.2	0.3
W	37,789	73	776	4.8	45.5	45.5	46.5	1.0
X	39,510	100	436	8.6	50.6	50.6	51.4	0.8
Y	39,608	81	867	4.3	59.4	59.4	59.4	0.0
Z	39,776	257	2,210	1.7	65.9	65.9	66.9	1.0

[1]Feet above confluence with Squamscott River

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH (ALL JURISDICTIONS)

FLOODWAY DATA

EXETER RIVER

TABLE 9

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Exeter River (continued)								
AA	41,626	135	1,276	2.9	66.1	66.1	67.0	0.9
AB	42,276	390	2,386	1.4	66.3	66.3	67.2	0.9
AC	52,603	274	1,215	2.7	67.2	67.2	67.9	0.7
AD	56,283	350	3,357	0.9	68.7	68.7	69.6	0.9
AE	58,143	99	508	5.9	70.0	70.0	70.5	0.5
AF	58,315	59	327	9.2	70.3	70.3	70.7	0.4
AG	61,175	97	1,104	2.7	73.7	73.7	74.0	0.3
AH	65,655	88	682	4.4	75.4	75.4	75.8	0.4
AI	66,895	67	555	5.4	76.7	76.7	77.0	0.3
AJ	69,895	74	621	4.8	80.3	80.3	80.6	0.3
AK	71,490	73	424	7.1	83.0	83.0	83.4	0.4
AL	72,560	43	233	12.9	91.4	91.4	92.0	0.6
AM	72,763	70	274	11.0	100.6	100.6	100.6	0.0
AN	72,842	70	467	6.4	104.5	104.5	104.6	0.1
AO	72,887	74	503	6.0	104.7	104.7	104.8	0.1
AP	73,031	36	297	10.1	104.7	104.7	104.8	0.1
AQ	73,165	164	1,218	2.5	107.2	107.2	107.2	0.0
AR	77,960	190	1,009	3.0	116.0	116.0	117.0	1.0
AS	78,530	64	393	7.7	120.4	120.4	120.4	0.0
AT	78,701	52	760	4.0	129.7	129.7	129.7	0.0
AU	78,751	89	1,468	2.1	133.7	133.7	133.7	0.0
AV	78,936	136	1,489	2.0	133.7	133.7	133.8	0.1
AW	80,076	109	743	3.9	133.9	133.9	134.0	0.1
AX	80,323	109	760	3.8	134.0	134.0	134.1	0.1
AY	80,373	219	1,519	1.9	134.2	134.2	134.3	0.1
AZ	80,360	219	1,546	1.9	135.3	135.3	135.3	0.0
BA	82,740	275	2,762	1.0	135.5	135.5	135.5	0.0
BB	84,960	185	1,684	1.9	135.6	135.6	135.8	0.2

[1]Feet above confluence with Squamscott River

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH (ALL JURISDICTIONS)

FLOODWAY DATA

EXETER RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Flatrock Brook								
A	0.209[1]	35	140	5.0	165.3	165.3	165.3	0.0
B	0.447[1]	68	272	2.6	169.1	169.1	170.0	0.9
C	0.737[1]	17	130	5.4	182.4	182.4	182.4	0.0
D	0.969[1]	37	180	2.9	182.9	182.9	183.9	1.0
E	1.325[1]	21	61	8.6	232.7	232.7	232.8	0.1
F	1.800[1]	24	89	4.0	240.1	240.1	240.8	0.7
Golden Brook								
A	3.705[2]	75	349	2.0	139.8	139.8	139.9	0.1
B	4.880[2]	100	524	1.4	151.4	151.4	152.3	0.9
C	5.728[2]	110	641	1.2	156.2	156.2	156.3	0.1
D	7.390[2]	21	57	6.7	177.9	177.9	177.9	0.0
E	7.962[2]	25	51	7.5	188.8	188.8	189.1	0.3
F	8.535[2]	21	65	5.9	208.4	208.4	208.7	0.3
G	8.649[2]	11	102	3.7	221.4	221.4	221.6	0.2
Hidden Valley Brook								
A	0.200[3]	17	81	3.6	210.2	208.4[4]	209.1	0.7
B	0.500[3]	13	93	3.1	218.0	218.0	218.0	0.0
C	0.900[3]	15	38	7.5	240.1	240.1	240.3	0.2
D	1.125[3]	20	51	4.1	249.1	249.1	249.5	0.4
E	1.383[3]	75	168	1.0	251.2	251.2	252.1	0.9
F	1.591[3]	40	63	2.7	267.7	267.7	267.9	0.2
G	2.073[3]	17	48	4.4	276.0	276.0	277.0	1.0

[1] Miles above confluence with Shadow Lake
[2] Miles above mouth
[3] Miles above confluence with Beaver Brook
[4] Elevation computed without consideration of backwater effects from Beaver Brook

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH
(ALL JURISDICTIONS)

FLOODWAY DATA

FLATROCK BROOK – GOLDEN BROOK – HIDDEN VALLEY BROOK

TABLE 9

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Hornes Brook								
A	0.083[1]	18	91	4.0	241.0	239.4[3]	240.1	0.7
B	0.347[1]	16	81	4.5	243.2	243.2	244.0	0.8
C	0.620[1]	18	84	4.4	250.6	250.6	251.3	0.7
D	0.758[1]	20	92	4.0	252.8	252.8	253.7	0.9
Kelly Brook								
A	575[2]	25	114	4.4	96.4	96.4	97.4	1.0
B	1,160[2]	40	122	4.1	98.2	98.2	98.9	0.7
C	4,000[2]	65	697	0.7	111.9	111.9	112.0	0.1
D	5,410[2]	40	328	1.5	111.9	111.9	112.1	0.2
E	6,930[2]	20	160	3.1	116.3	116.3	117.1	0.8
F	7,490[2]	30	143	3.5	116.7	116.7	117.6	0.9
G	8,880[2]	45	104	4.8	123.5	123.5	124.1	0.6
H	9,135[2]	30	76	6.5	125.6	125.6	125.9	0.3

[1]Miles above confluence with Beaver Brook
[2]Feet above confluence with Little River No. 3
[3]Elevation computed without consideration of backwater effects from Beaver Brook

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH (ALL JURISDICTIONS)

FLOODWAY DATA

HORNES BROOK – KELLY BROOK

TABLE 9

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Lamprey River								
A	0	119	1,319	4.3	95.4	95.4	96.4	1.0
B	5,550	356	2,746	1.8	97.9	97.9	98.9	1.0
C	10,960	97	1,267	3.9	100.1	100.1	101.1	1.0
D	16,510	261	2,436	2.0	102.3	102.3	103.3	1.0
E	19,310	199	2,339	2.1	102.8	102.8	103.8	1.0
F	19,440	414	3,926	1.3	103.0	103.0	104.0	1.0
G	29,570	498	3,886	1.3	105.6	105.6	106.6	1.0
H	32,620	112	1,233	4.0	107.2	107.2	108.2	1.0
I	36,130	100	1,064	4.6	109.5	109.5	110.5	1.0
J	36,900	138	1,462	3.4	110.4	110.4	111.4	1.0
K	37,240	149	1,451	3.4	110.8	110.8	111.8	1.0
L	37,980	149	2,251	2.2	111.5	111.5	111.6	0.1
M	38,220	102	1,157	4.3	112.3	112.3	113.3	1.0
N	41,620	390	3,465	1.4	113.5	113.5	114.5	1.0
O	44,620	105	1,119	4.2	115.6	115.6	116.6	1.0
P	54,730	112	1,400	3.4	138.0	138.0	139.0	1.0
Q	57,290	163	1,930	2.5	138.8	138.8	139.8	1.0
R	57,660	199	2,052	2.0	138.9	138.9	139.9	1.0
S	57,740	198	1,034	4.0	138.9	138.9	139.9	1.0
T	58,440	161	1,859	2.3	147.6	147.6	148.6	1.0
U	64,620	123	1,045	4.0	153.0	153.0	154.0	1.0
V	66,900	128	1,256	3.3	155.4	155.4	156.4	1.0
W	69,780	86	817	6.5	163.7	163.7	164.7	1.0
X	71,330	137	1,322	4.0	165.7	165.7	166.7	1.0
Y	71,470	99	981	5.4	166.3	166.3	167.3	1.0
Z	77,180	227	2,147	2.5	167.8	167.8	168.8	1.0

[1]Feet above county boundary

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH (ALL JURISDICTIONS)

FLOODWAY DATA

LAMPREY RIVER

TABLE 9

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Lamprey River (continued)								
AA	77,760	113	502	10.5	177.1	177.1	178.1	1.0
AB	77,810	120	501	10.6	178.6	178.6	179.6	1.0
AC	78,190	156	1,197	4.4	181.0	181.0	182.0	1.0
AD	83,080	159	1,658	3.19	184.7	184.7	185.7	1.0
AE	83,910	102	1,277	4.14	185.9	185.9	186.9	1.0
AF	84,610	107	1,149	4.61	186.4	186.4	187.4	1.0
AG	84,830	279	4,359	1.21	190.1	190.1	191.1	1.0
AH	89,830	205	2,666	1.98	190.3	190.3	191.3	1.0
AI	95,610	270	3,362	1.30	190.8	190.8	191.8	1.0
AJ	97,110	51	635	6.88	193.1	193.1	194.1	1.0
AK	97,380	144	1,411	3.10	195.8	195.8	196.8	1.0
AL	98,230	177	1,490	2.93	196.4	196.4	197.4	1.0
AM	101,400	317	1,560	2.80	200.6	200.6	201.6	1.0
AN	102,430	81	684	6.39	202.6	202.6	203.6	1.0
AO	105,160	81	787	5.55	206.7	206.7	207.7	1.0
AP	107,920	138	1,629	2.68	207.9	207.9	208.9	1.0
AQ	110,110	237	2,271	1.45	211.7	211.7	212.7	1.0
AR	110,410	134	1,568	2.10	213.0	213.0	214.0	1.0
AS	113,530	96	1,041	3.17	214.4	214.4	215.4	1.0
AT	115,130	150	994	3.32	216.4	216.4	217.4	1.0
AU	116,790	203	2,305	1.43	216.7	216.7	217.7	1.0
AV	119,400	1,407	9,085	0.36	216.8	216.8	217.8	1.0

[1]Feet above county boundary

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH
(ALL JURISDICTIONS)

FLOODWAY DATA

LAMPREY RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Little Cohas Brook								
A	0.141[1]	20	52	9.2	200.4	200.4	200.4	0.0
B	0.547[1]	30	112	4.3	212.1	212.1	212.2	0.1
C	0.678[1]	30	73	6.6	229.2	229.2	229.2	0.0
D	0.900[1]	40	56	6.9	242.7	242.7	242.7	0.0
E	1.165[1]	180	720	0.5	261.1	261.1	261.1	0.0
F	1.228[1]	630	3,062	0.1	263.7	263.7	263.7	0.0
G	1.775[1]	105	487	0.8	263.7	263.7	263.7	0.0
H	2.365[1]	30	175	1.8	264.3	264.3	264.4	0.1
I	2.717[1]	300	396	0.8	264.3	264.3	265.1	0.8
J	3.405[1]	20	25	6.8	306.8	306.8	306.8	0.0
Little River No. 1								
A	400[2]	195	1,679	0.4	31.7	28.8[3]	28.8	0.0
B	610[2]	80	803	0.8	31.7	28.8[3]	28.8	0.0
C	2,460[2]	70	615	1.0	31.7	28.8[3]	28.9	0.1
D	2,604[2]	99	839	0.7	31.7	28.9[3]	29.0	0.1
E	4,104[2]	29	183	3.4	31.7	29.0[3]	29.1	0.1
F	5,104[2]	44	351	1.8	31.7	29.0[3]	29.8	0.8
G	5,234[2]	214	1,118	0.6	31.7	29.4[3]	30.2	0.8
H	7,634[2]	76	504	1.2	31.7	29.7[3]	30.5	0.8
I	7,934[2]	76	696	0.9	31.7	29.8[3]	30.7	0.9
J	8,069[2]	78	287	2.2	31.7	30.6[3]	31.2	0.6
K	9,219[2]	122	427	1.5	31.7	31.5[3]	32.2	0.7
L	10,169[2]	164	800	0.8	31.7	31.7	32.4	0.7
M	10,246[2]	21	128	4.9	31.7	31.7	32.4	0.7

[1]Miles above Industrial Drive
[2]Feet above confluence with Exeter River
[3]Elevation computed without consideration of backwater effects from Exeter River

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH
(ALL JURISDICTIONS)

FLOODWAY DATA

LITTLE COHAS BROOK – LITTLE RIVER NO. 1

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Little River No. 1 (continued)								
N	10,566[1]	80	430	1.5	32.4	32.4	33.0	0.6
O	11,866[1]	32	173	3.6	32.7	32.7	33.4	0.7
P	12,666[1]	55	87	7.2	40.4	40.4	40.7	0.3
Q	12,799[1]	205	1,221	0.5	47.5	47.5	47.6	0.1
Little River No. 2								
A	3,048[2]	67	302	0.7	10.0	10.0	10.1	0.1
B	5,048[2]	*	78	2.9	10.3	10.3	10.8	0.5
C	5,185[2]	*	59	3.8	10.7	10.7	11.1	0.4
D	5,385[2]	*	32	7.2	12.5	12.5	12.5	0.0
E	5,490[2]	*	31	7.3	14.5	14.5	14.7	0.2
F	5,780[2]	*	25	9.0	21.6	21.6	21.7	0.1
G	6,420[2]	*	31	7.4	27.0	27.0	27.0	0.0
H	6,495[2]	*	32	7.2	31.6	31.6	31.7	0.1
I	6,561[2]	75	410	0.6	35.3	35.3	35.5	0.2
J	6,771[2]	*	25	9.0	35.5	35.5	35.5	0.0
K	6,867[2]	*	49	4.6	39.0	39.0	39.0	0.0

[1]Feet above confluence with Exeter River
[2]Feet above downstream dam in Town of North Hampton
*Floodway coincident with channel banks

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH
(ALL JURISDICTIONS)

FLOODWAY DATA

LITTLE RIVER NO. 1 – LITTLE RIVER NO. 2

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Little River No. 3								
A	290	40	213	6.0	39.7	39.7	40.4	0.7
B	1,600	30	281	4.5	42.2	42.2	42.9	0.7
C	3,110	119	614	1.8	43.1	43.1	44.1	1.0
D	3,265	85	574	1.9	43.7	43.7	44.5	0.8
E	4,640	91	285	3.8	45.0	45.0	45.9	0.9
F	5,035	42	243	4.4	47.4	47.4	47.5	0.1
G	5,340	35	205	5.2	49.9	49.9	49.9	0.0
H	7,490	32	197	5.5	54.6	54.6	55.1	0.5
I	8,704	40	120	9.0	58.4	58.4	58.4	0.0
J	10,030	135	850	0.9	60.1	60.1	61.1	1.0
K	10,480	60	327	2.4	61.8	61.8	62.6	0.8
L	11,450	145	880	0.9	61.9	61.9	62.8	0.9
M	12,660	70	278	2.9	62.6	62.6	63.4	0.8
N	14,850	48	250	3.2	64.7	64.7	65.4	0.7
O	15,730	53	163	4.9	68.3	68.3	69.1	0.8
P	16,850	20	161	4.9	81.8	81.8	81.8	0.0
Q	17,770	39	91	8.7	86.4	86.4	86.4	0.0
R	19,420	33	142	5.6	93.3	93.3	93.8	0.5
S	20,690	70	314	2.5	95.2	95.2	96.0	0.8
T	21,970	34	153	5.2	96.3	96.3	97.1	0.8
U	23,066	50	254	1.9	102.9	102.9	102.9	0.0
V	25,410	51	326	1.5	103.1	103.1	103.5	0.4
W	27,555	58	225	1.5	103.5	103.5	104.2	0.7
X	28,240	22	127	2.6	106.9	106.9	106.9	0.0

[1]Feet above New Hampshire-Massachusetts State boundary

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH
(ALL JURISDICTIONS)

FLOODWAY DATA

LITTLE RIVER NO. 3

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Nesenkeag Brook								
A	0.278[1]	150	228	3.3	178.7	178.7	179.4	0.7
B	0.730[1]	20	37	5.7	190.9	190.9	191.1	0.2
C	1.262[1]	20	62	3.4	196.1	196.1	196.6	0.5
D	1.665[1]	30	33	6.4	225.2	225.2	225.2	0.0
E	1.900[1]	30	89	2.4	229.6	229.6	229.8	0.2
F	2.245[1]	30	30	7.0	251.9	251.9	251.9	0.0
G	3.247[1]	30	210	1.0	271.7	271.7	272.6	0.9
H	3.381[1]	20	123	1.7	273.6	273.6	273.6	0.0
I	3.533[1]	10	137	1.5	289.6	289.6	289.6	0.0
Piscassic River								
A	4,630[2]	68	341	1.1	92.1	92.1	93.1	1.0
B	6,530[2]	30	177	2.1	94.9	94.9	95.9	1.0
C	7,120[2]	26	121	3.1	98.6	98.6	99.6	1.0
D	9,575[2]	95	305	1.2	100.8	100.8	101.8	1.0
Policy Brook								
A	0[3]	50	160	4.1	124.0	124.0	125.0	1.0
B	1,030[3]	50	170	3.9	126.0	126.0	126.6	0.6
C	1,105[3]	50	250	1.8	126.4	126.4	127.0	0.6
D	1,190[3]	50	230	2.0	126.5	126.5	127.1	0.6
E	1,240[3]	50	400	1.1	126.5	126.5	127.1	0.6
F	3,185[3]	50	300	1.1	126.6	126.6	127.3	0.7
G	4,025[3]	50	280	0.7	126.6	126.6	127.3	0.7
Unnamed Brook								
H	4,075[3]	50	210	0.6	126.6	126.6	127.3	0.7
I	4,750[3]	50	95	1.3	127.0	127.0	127.7	0.7
J	4,965[3]	50	170	0.7	127.1	127.1	127.8	0.7
K	5,755[3]	50	95	0.6	127.1	127.1	127.9	0.8

[1]Miles above county boundary
[2]Feet above Ice Pond Dam
[3]Feet above Rockingham park culvert

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH
(ALL JURISDICTIONS)

FLOODWAY DATA

NESENKEAG BROOK – PISCASSIC RIVER – POLICY BROOK – UNNAMED BROOK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Shields Brook								
A	1.149	20	45	8.2	263.8	263.8	263.8	0.0
B	1.415	16	96	3.8	276.3	276.3	276.3	0.0
C	1.815	45	47	5.9	294.0	294.0	294.0	0.0
D	1.949	30	41	6.7	297.9	297.9	297.9	0.0
E	2.030	47	158	1.7	301.6	301.6	302.2	0.6
F	2.116	18	157	1.8	307.1	307.1	307.1	0.0
G	2.170	40	240	1.2	307.3	307.3	307.3	0.0
H	2.669	94	167	1.7	307.7	307.7	308.6	0.9
I	2.852	20	92	3.0	313.1	313.1	314.1	1.0
J	3.008	8	27	10.2	333.6	333.6	333.6	0.0
K	3.178	9	86	1.7	351.6	351.6	352.0	0.4
L	3.372	20	123	1.2	352.7	352.7	353.3	0.6
M	3.953	20	82	1.8	366.0	366.0	366.9	0.9
N	4.488	16	96	1.6	374.2	374.2	374.2	0.0

[1]Miles above confluence with Beaver Creek

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH
(ALL JURISDICTIONS)

FLOODWAY DATA

SHIELDS BROOK

TABLE 9

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Spicket River								
A	33.12	300	1,710	1.1	112.0	112.0	113.0	1.0
B	33.78	300	1,440	1.1	112.3	112.3	113.3	1.0
C	34.60	250	1,310	1.2	113.0	113.0	113.9	0.9
D	34.74	140	630	2.5	114.4	114.4	115.3	0.9
E	35.05	250	1,680	1.0	114.9	114.9	115.7	0.8
F	35.62	250	1,560	1.0	115.0	115.0	115.8	0.8
G	36.45	250	1,420	1.1	115.5	115.5	116.2	0.7
H	36.92	190	1,180	1.4	115.7	115.7	116.4	0.7
I	36.97	300	1,500	1.1	116.5	116.5	117.2	0.7
J	38.05	300	2,040	0.8	117.3	117.3	118.0	0.7
K	38.46	300	980	1.6	117.5	117.5	118.2	0.7
L	38.93	100	620	2.6	119.0	119.0	119.3	0.3
M	38.98	100	560	2.9	119.6	119.6	119.7	0.1
N	39.27	200	1,320	1.2	119.7	119.7	120.2	0.5
O	39.59	130	730	2.2	119.8	119.8	120.3	0.5
P	39.64	250	1,340	1.2	119.9	119.9	120.4	0.5
Q	40.66	250	1,380	1.2	120.6	120.6	121.1	0.5
R	40.82	250	1,500	1.2	120.7	120.7	121.3	0.6
S	40.87	250	1,840	0.8	121.8	121.8	122.5	0.7
T	41.87	180	760	1.8	122.3	122.3	122.9	0.6
U	42.47	200	1,350	1.0	126.3	126.3	126.3	0.0
V	42.74	60	460	1.6	126.4	126.4	126.5	0.1
W	43.11	100	450	1.7	127.1	127.1	127.2	0.1

[1]Miles above Newburyport Light

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH
(ALL JURISDICTIONS)

FLOODWAY DATA

SPICKET RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Taylor Brook (including Ballard Pond)								
A	0.225[1]	30	110	3.9	207.0	207.0	207.8	0.8
B	0.933[1]	19	87	4.9	218.2	218.2	218.9	0.7
C	1.638[1]	20	58	7.3	238.5	238.5	238.9	0.4
D	2.950[1]	208	1,085	0.8	258.4	258.4	259.4	1.0
E	3.153[1]	49	553	1.5	262.9	262.9	262.9	0.0
Tributary C to Beaver Brook								
A	0.092[2]	70	290	1.3	223.4	219.4[3]	220.3	0.9
B	0.571[2]	25	52	7.3	234.3	234.3	234.3	0.0
C	0.755[2]	30	51	7.5	247.1	247.1	247.1	0.0
D	0.960[2]	20	187	1.3	279.0	279.0	279.0	0.0
E	1.310[2]	40	47	5.1	292.3	292.3	292.3	0.0
F	1.800[2]	80	202	1.2	299.6	299.6	300.1	0.5
G	2.215[2]	160	230	1.0	304.6	304.6	305.6	1.0
Tributary G to Beaver Brook								
A	0.395[2]	50	489	1.5	248.0	243.7[3]	244.7	1.0
B	0.822[2]	18	532	1.0	265.4	265.4	265.8	0.4
C	1.181[2]	81	547	0.9	273.2	273.2	274.0	0.8
D	1.735[2]	16	567	0.9	281.9	281.9	282.8	0.9

[1]Miles above confluence with Island Pond
[2]Miles above confluence with Beaver Brook
[3]Elevation computed without consideration of backwater effects from Beaver Brook

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH
(ALL JURISDICTIONS)

FLOODWAY DATA

TAYLOR BROOK (INCLUDING BALLARD POND) - TRIBUTARY C TO BEAVER BROOK – TRIBUTARY G TO BEAVER BROOK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Tributary O to Beaver Brook								
A	0.019[1]	30	48	5.2	239.1	235.0[3]	235.3	0.3
B	0.184[1]	35	104	2.4	239.1	237.9[3]	238.7	0.8
C	0.387[1]	20	38	6.1	245.9	245.9	246.2	0.3
D	0.585[1]	20	107	2.2	283.6	283.6	283.6	0.0
E	0.726[1]	350	2,576	0.1	285.4	285.4	285.4	0.0
F	0.926[1]	20	38	6.1	286.1	286.1	286.1	0.0
G	1.009[1]	30	114	2.0	290.4	290.4	291.2	0.8
H	1.121[1]	10	92	2.5	292.1	292.1	292.9	0.8
I	1.234[1]	20	101	2.3	305.4	305.4	305.4	0.0
J	1.453[1]	10	29	7.9	320.3	320.3	320.5	0.2
Tributary E to Beaver Lake								
A	0.000[2]	28	162	2.3	289.6	289.6	290.6	1.0
B	0.184[2]	36	467	0.8	293.6	293.6	294.3	0.7
Tributary F to Beaver Lake								
A	0.169[2]	102	589	1.1	297.6	297.6	298.6	1.0
B	0.471[2]	311	1,133	0.6	299.3	299.3	300.2	0.9
C	0.770[2]	59	226	2.9	303.5	303.5	304.5	1.0
D	1.064[2]	19	65	10.1	320.7	320.7	320.7	0.0

[1]Miles above confluence with Beaver Brook
[2]Miles above confluence with Beaver Lake
[3]Elevation computed without consideration of backwater effects from Beaver Brook

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH
(ALL JURISDICTIONS)

FLOODWAY DATA

TRIBUTARY O TO BEAVER BROOK – TRIBUTARY E TO BEAVER LAKE - TRIBUTARY F TO BEAVER LAKE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Tributary J to Black Brook								
A	0.191[1]	20	33	5.0	215.4	215.4	216.0	0.6
B	0.400[1]	20	94	1.8	221.1	221.1	221.5	0.4
C	0.613[1]	60	207	0.8	221.2	221.2	221.9	0.7
D	0.951[1]	30	103	1.6	221.8	221.8	222.8	1.0
E	1.145[1]	30	75	2.2	224.5	224.5	225.4	0.9
Tributary H to Drew Brook								
A	0.235[2]	26	52	4.8	216.9	216.9	217.3	0.4
B	0.503[2]	10	60	4.2	226.1	226.1	226.4	0.3
C	0.810[2]	14	30	8.4	245.1	245.1	245.3	0.2
D	1.030[2]	13	33	7.6	263.6	263.6	264.1	0.5
E	1.156[2]	17	40	6.3	277.3	277.3	277.6	0.3
Tributary E to Little Cohas Brook								
A	0.240[3]	60	205	2.1	264.1	262.4[4]	263.2	0.8
B	0.700[3]	40	118	2.8	264.1	262.5[4]	263.5	1.0
C	0.950[3]	30	107	3.1	266.1	266.1	266.1	0.0
D	1.083[3]	20	127	2.3	272.5	272.5	272.7	0.2
E	1.300[3]	100	538	0.5	276.9	276.9	277.3	0.4
F	1.535[3]	25	168	1.7	279.6	279.6	280.1	0.5
G	1.596[3]	10	63	4.6	281.3	281.3	281.3	0.0

[1]Miles above confluence with Black Brook
[2]Miles above confluence with Drew Brook
[3]Miles above confluence with Little Cohas Brook
[4]Elevation computed without consideration of backwater effects from Little Cohas Brook

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH (ALL JURISDICTIONS)

FLOODWAY DATA

TRIBUTARY J TO BLACK BROOK – TRIBUTARY H TO DREW BROOK - TRIBUTARY E TO LITTLE COHAS BROOK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Tributary H to Nesenkeag Brook								
A	0.065[1]	30	69	5.4	185.0	185.0	185.0	0.0
B	0.350[1]	20	21	7.6	202.1	202.1	202.1	0.0
C	0.700[1]	20	23	7.0	232.3	232.3	232.3	0.0
D	1.151[1]	35	121	1.3	236.2	236.2	237.0	0.8
Upper Beaver Brook								
A	0.120[2]	20	38	5.7	314.3	314.3	314.3	0.0
B	0.300[2]	20	68	3.2	319.4	319.4	319.5	0.1
C	0.592[2]	20	45	4.8	331.6	331.6	331.6	0.0
D	0.900[2]	150	390	0.6	331.6	331.6	332.5	0.9
E	1.415[2]	300	824	0.3	331.7	331.7	332.7	1.0

[1]Miles above confluence with Nesenkeag Brook
[2]Miles above confluence with Shields Brook

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH
(ALL JURISDICTIONS)

FLOODWAY DATA

TRIBUTARY H TO NESENKEAG BROOK – UPPER BEAVER BROOK

TABLE 9

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Winnicut River								
A	1,200	32	112	1.8	41.6	41.6	41.6	0.0
B	3,040	*	112	1.8	42.5	42.5	43.3	0.8
C	4,240	97	261	0.8	43.0	43.0	44.0	1.0
D	4,372	51	239	0.8	45.2	45.2	45.2	0.0
E	6,272	*	74	2.7	45.3	45.3	45.8	0.5
F	7,472	54	223	0.9	45.5	45.5	46.2	0.7
G	7,662	*	126	1.6	49.4	49.4	49.6	0.2
H	9,762	505	2,667	0.1	49.4	49.4	49.6	0.2
I	12,322	90	581	0.3	49.4	49.4	49.7	0.3
J	13,842	256	630	0.3	49.4	49.4	49.7	0.3
K	14,056	250	1,866	0.1	53.2	53.2	53.3	0.1
L	15,056	240	1,060	0.2	53.2	53.2	53.3	0.1
M	15,279	340	3,607	0.1	56.5	56.5	56.5	0.0

[1]Feet above Town of North Hampton corporate limits
*Floodway coincident with channel banks

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH
(ALL JURISDICTIONS)

FLOODWAY DATA

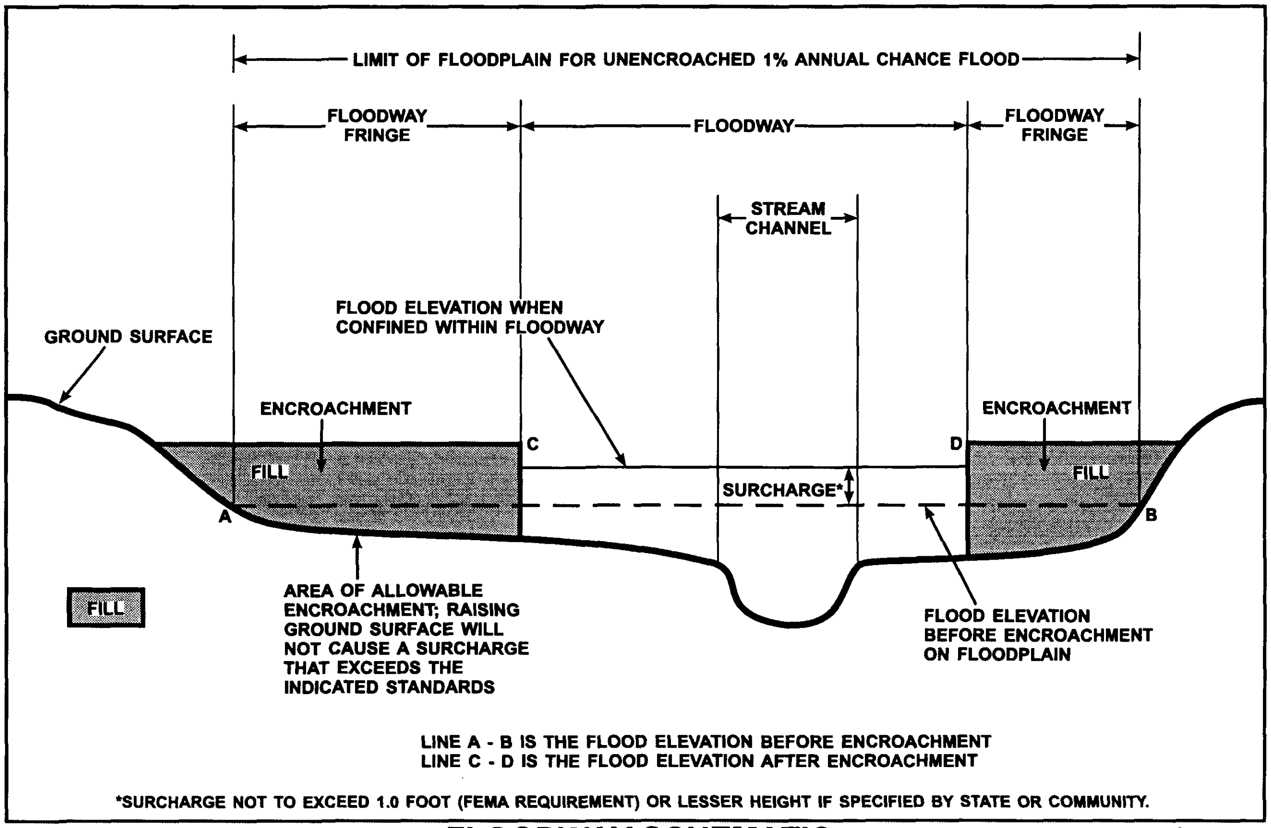
WINNICUT RIVER

Portions of the floodways for Beaver Brook extend beyond the county boundary. No floodway was computed for Grassy Brook, Hill Brook, Hog Hill Brook, Porcupine Brook, Porcupine Brook Tributary, Powwow River (Downstream Reach), Powwow River (Upstream Reach), Squamscott River, Wash Pond Tributary, West Channel Policy Brook, and portions of the Lamprey River and Pickering Brook.

Encroachment into areas subject to inundation by floodwaters having hazardous velocities aggravates the risk of flood damage, and heightens potential flood hazards by further increasing velocities. A listing of stream velocities at selected cross sections is provided in Table 9, "Floodway Data." In order to reduce the risk of property damage in areas where the stream velocities are high, the community may wish to restrict development in areas outside the floodway.

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "Without Floodway" elevations presented in Table 9 for certain downstream cross sections of Black Brook, Hidden Valley Brook, Hornes Brook, Little River No. 1, Tributary C to Beaver Brook, Tributary G to Beaver Brook, Tributary O to Beaver Brook, Tributary E to Little Cohas Brook, and Tributary H to Nesenkeag Brook are lower than the regulatory flood elevations in that area, which must take into account the 100-year flooding due to backwater from other sources.

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 3.



FLOODWAY SCHEMATIC Figure 3

5.0 INSURANCE APPLICATIONS

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. The zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the FIS by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the FIS by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone AR

Area of special flood hazard formerly protected from the 1% annual chance flood event by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood event.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, and to areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The FIRM is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100- and 500-year floodplains. Floodways and the locations of selected cross sections used in the hydraulic analyses and floodway computations are shown where applicable.

The current FIRM presents flooding information for the entire geographic area of Rockingham County. Previously, separate FIRMs were prepared for each identified flood-prone incorporated community and the unincorporated areas of the county. This countywide FIRM also includes flood hazard information that was presented separately on FBFMs, where applicable. Historical data relating to the maps prepared for each community, up to and including this countywide FIS, are presented in Table 10, "Community Map History."

7.0 OTHER STUDIES

FISs have been prepared for Essex County, Massachusetts: the Cities of Haverhill (FEMA, February 1983) and Methuen (FEMA, June 1987); and the Towns of Amesbury (FEMA, October 1982), Merrimac (FEMA, January 1982), and Salisbury (FEMA, September 1986). FISs have been prepared for Hillsborough County, New Hampshire: the City of Manchester (FEMA, August 1980); and the Towns of Bedford (FEMA, May 1994), Hudson (FEMA, January 1978), Litchfield (FEMA, November 1977), Merrimack (FEMA, July 1979), and Pelham (FEMA, September 1979). FISs have been prepared for Merrimack County, New Hampshire: the Towns of Allenstown (FEMA, October 1979), Epsom (FEMA, July 1978), Hooksett (FEMA, March 1982), and Pittsfield (FEMA, July 1978). FISs have been prepared for Strafford County, New Hampshire: the City of Dover (FEMA, October 1979); and the Towns of Durham (FEMA, May 1991), Lee (FEMA, April 1986), and Strafford (FEMA, May 2002). FISs have been prepared for York County, Maine: the Towns of Eliot (FEMA, June 1989) and Kittery (FEMA, April 1983).

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Atkinson, Town of	January 3, 1975	November 29, 1977	April 2, 1993	May 17, 2005
Auburn, Town of	February 28, 1975	None	April 4, 1986	May 17, 2005
Brentwood, Town of	June 28, 1974	December 10, 1976	April 15, 1981	May 4, 2000 May 17, 2005
Candia, Town of	February 21, 1975	November 19, 1976	May 17, 2005	
Chester, Town of	February 21, 1975	None	March 1, 2000	May 17, 2005
Danville, Town of	January 17, 1975	None	April 1, 1994	May 17, 2005
Deerfield, Town of	February 21, 1975	November 12, 1976	September 1, 1989	May 17, 2005
Derry, Town of	September 13, 1974	March 4, 1977	April 15, 1981	May 17, 2005
East Kingston, Town of	February 28, 1975	None	April 2, 1986	May 17, 2005
Epping, Town of	July 19, 1974	November 15, 1977	April 15, 1982	May 17, 2005
Exeter, Town of	September 20, 1974	March 11, 1977	May 17, 1982	May 17, 2005
Fremont, Town of	August 9, 1974	October 29, 1976 August 17, 1979	April 15, 1981	June 19, 1989 May 17, 2005
Greenland, Town of	February 21, 1975	September 17, 1976	May 17, 1989	May 17, 2005
Hampstead, Town of	February 28, 1975	None	June 16, 1993	May 17, 2005

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH
(ALL JURISDICTIONS)

COMMUNITY MAP HISTORY

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Hampton, Town of	July 19, 1974	December 10, 1976	July 3, 1986	May 17, 2005
Hampton Falls, Town of	December 6, 1974	June 11, 1976	April 15, 1982	May 17, 2005
Kensington, Town of	September 6, 1977	None	May 17, 2005	
Kingston, Town of	January 17, 1975	March 6, 1979	September 1, 1988	April 15, 1992 May 17, 2005
Londonderry, Town of	August 9, 1974	July 16, 1976	November 5, 1980	May 17, 2005
New Castle, Town of	May 31, 1974	December 3, 1976	August 5, 1986	May 17, 2005
Newfields, Town of	January 17, 1975	March 12, 1976	June 5, 1989	May 17, 2005
Newington, Town of	February 21, 1975	None	May 17, 2005	
Newmarket, Town of	June 28, 1974	December 10, 1976	May 2, 1991	May 17, 2005
Newton, Town of	May 17, 2005	None	May 17, 2005	
North Hampton, Town of	February 27, 1979	None	June 3, 1986	May 17, 2005
Northwood, Town of	January 2, 1987	None	January 2, 1987	May 17, 2005
Nottingham, Town of	June 28, 1974	November 19, 1976 September 7, 1979	April 2, 1986	May 17, 2005
Plaistow, Town of	October 18, 1974	August 27, 1976	April 15, 1981	May 17, 2005

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH
(ALL JURISDICTIONS)

COMMUNITY MAP HISTORY

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Portsmouth, City of	July 19, 1974	July 23, 1976	May 17, 1982	May 17, 2005
Raymond, Town of	August 9, 1974	July 2, 1976	April 15, 1982	April 15, 1992 May 2, 1995 May 17, 2005
Rye, Town of	June 28, 1974	September 3, 1976	June 17, 1986	May 17, 2005
Salem, Town of	April 29, 1977	None	June 15, 1979	April 6, 1998 May 17, 2005
Sandown, Town of	January 3, 1975	None	May 17, 2005	
Seabrook, Town of	August 2, 1974	November 26, 1976	July 17, 1986	May 17, 2005
Seabrook Beach Village District	August 2, 1974[1]	November 26, 1976[1]	August 5, 1986	May 17, 2005
South Hampton, Town of	February 28, 1975	None	June 1, 1989	July 15, 1992 May 17, 2005
Stratham, Town of	February 28, 1975	None	May 17, 1989	May 17, 2005
Windham, Town of	August 16, 1974	January 23, 1976	April 1, 1980	November 3, 1989 May 17, 2005

[1]The land area for this community was previously shown on the FHBM for the Town of Seabrook as a portion of the town. It has now been identified as a separate NFIP community. Therefore, the dates for this community were taken from the FHBM for the Town of Seabrook.

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH
(ALL JURISDICTIONS)

COMMUNITY MAP HISTORY

TABLE 10

Using National Ocean Survey tide gage data, the USACE predicted 10-, 50-, 100-, and 500-year flood levels at Boston, Massachusetts, and Portsmouth, New Hampshire. Their results compare favorably with flood elevations determined in the precountywide studies considering the distance between Rockingham County and the National Ocean Survey gaging stations.

Information pertaining to revised and unrevised flood hazards for each jurisdiction within Rockingham County has been compiled into this FIS. Therefore, this FIS supersedes all previously printed FIS reports, FBFMs, and FIRMs for all jurisdictions within Rockingham County.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this FIS can be obtained by contacting FEMA, Federal Insurance and Mitigation Division, Federal Regional Center, J.W. McCormack Post Office and Courthouse Building, Room 462, Boston, Massachusetts 02109.

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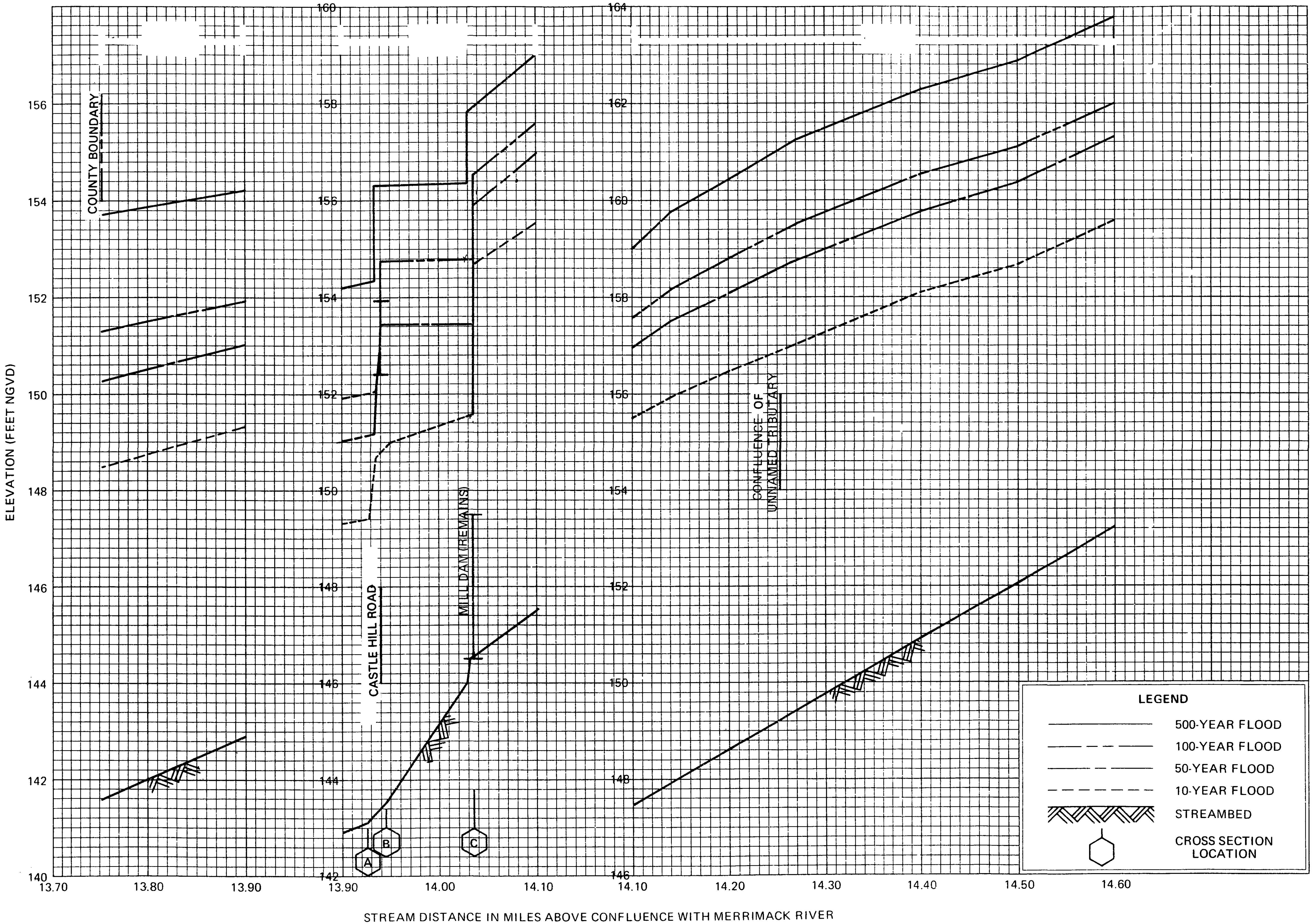


FLOOD PROFILES

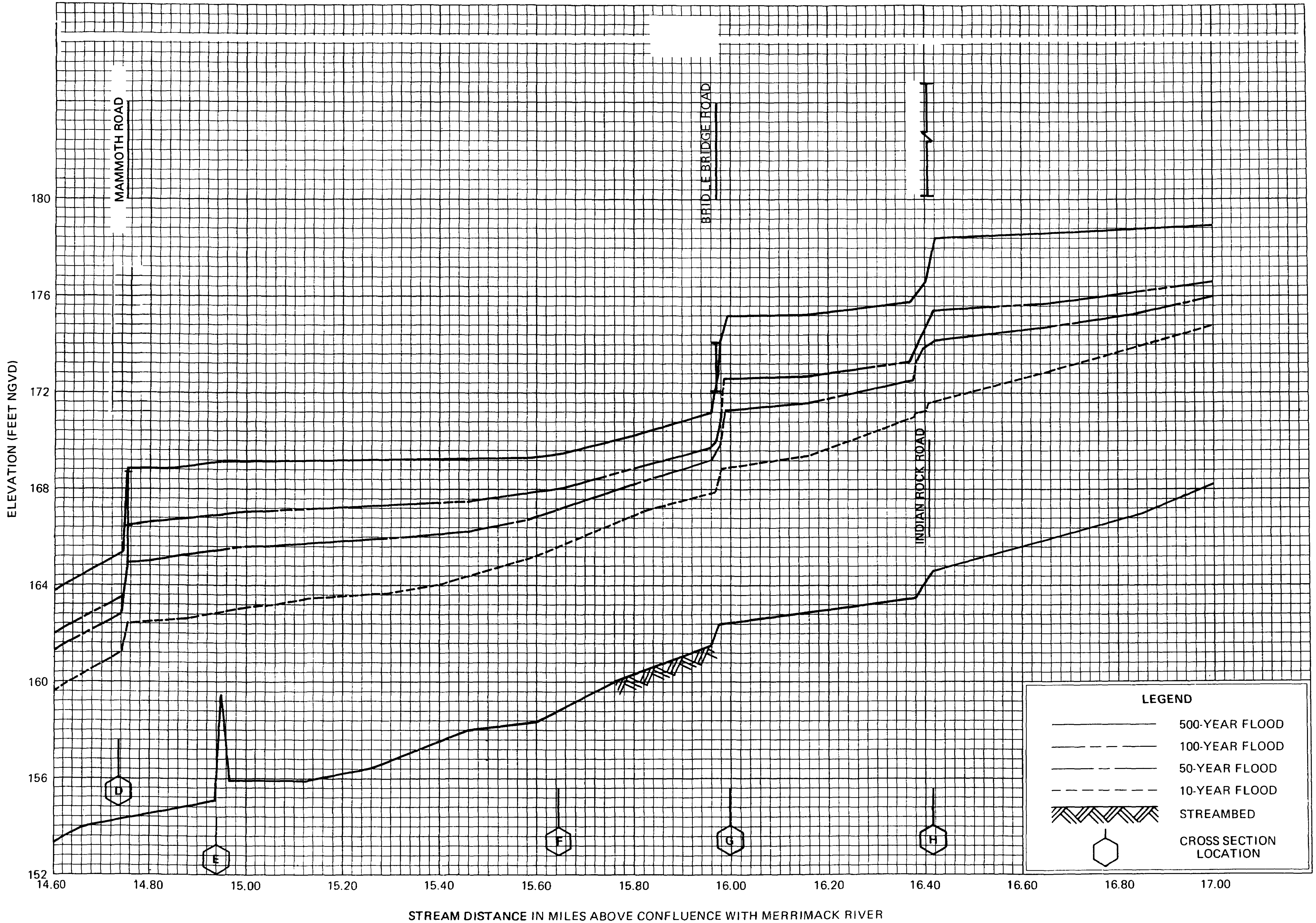
BEAVER BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH

(ALL JURISDICTIONS)

01P



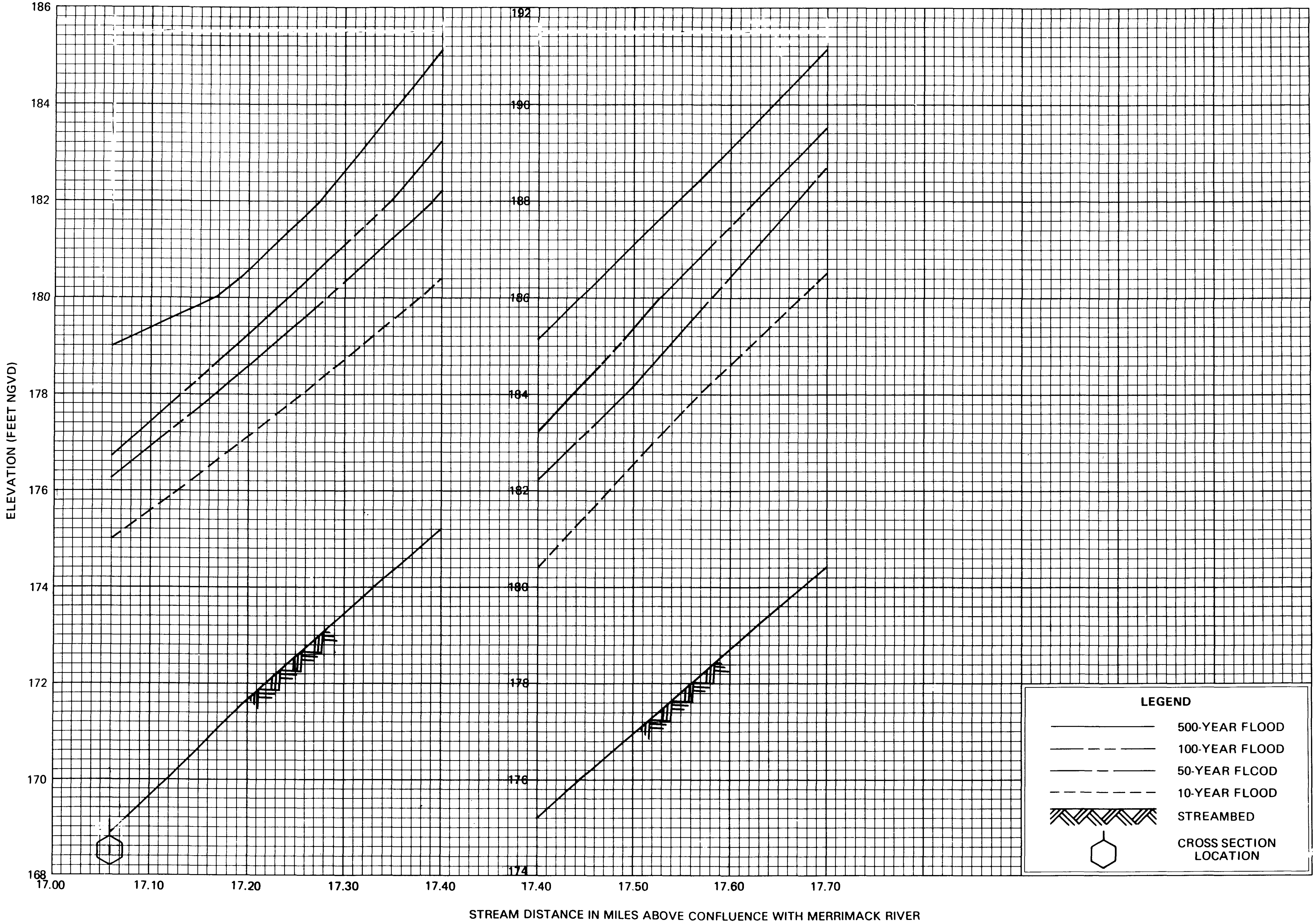
FLOOD PROFILES

BEAVER BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH
(ALL JURISDICTIONS)

02P



FLOOD PROFILES

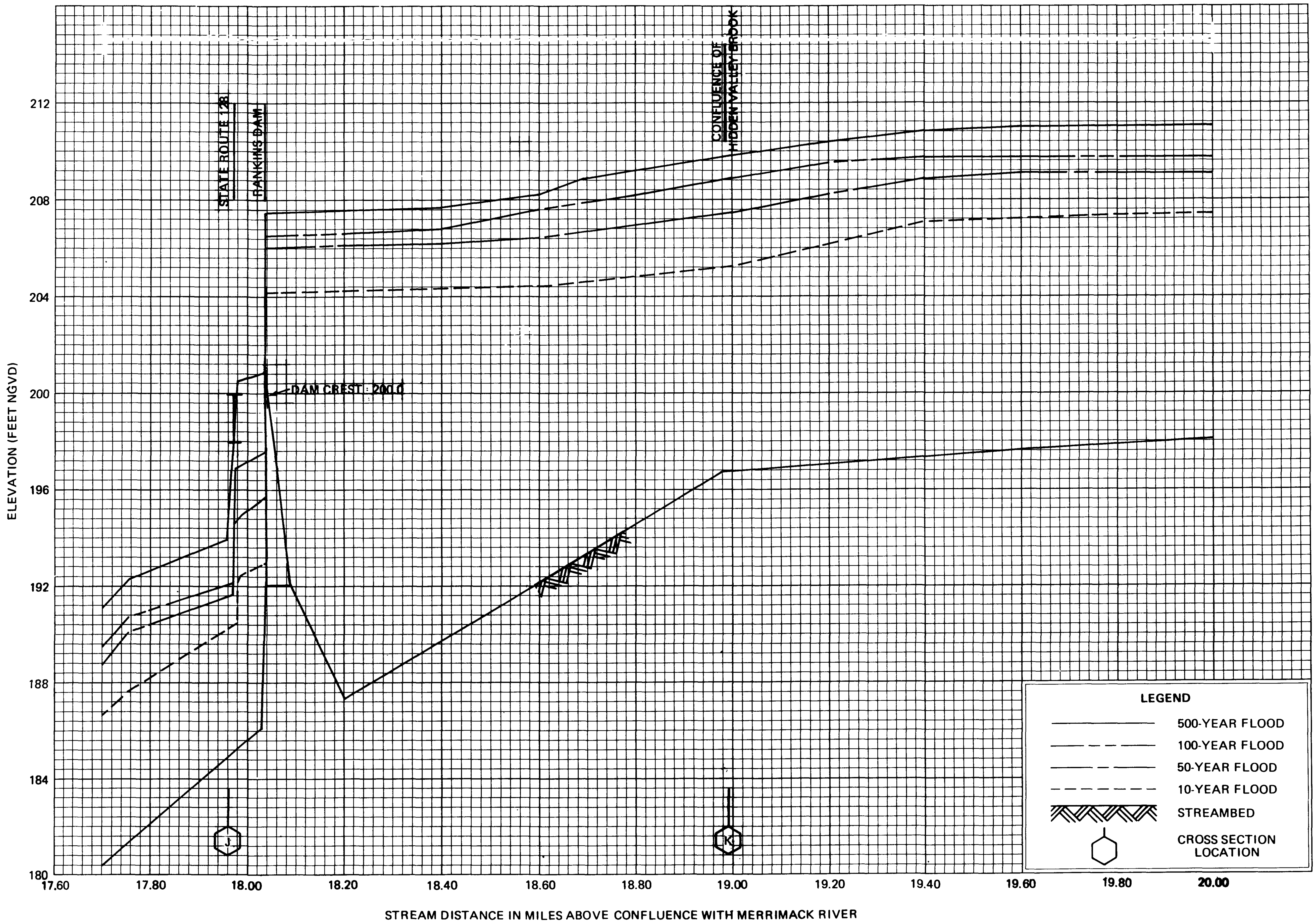
BEAVER BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH

(ALL JURISDICTIONS)

03P



FLOOD PROFILES

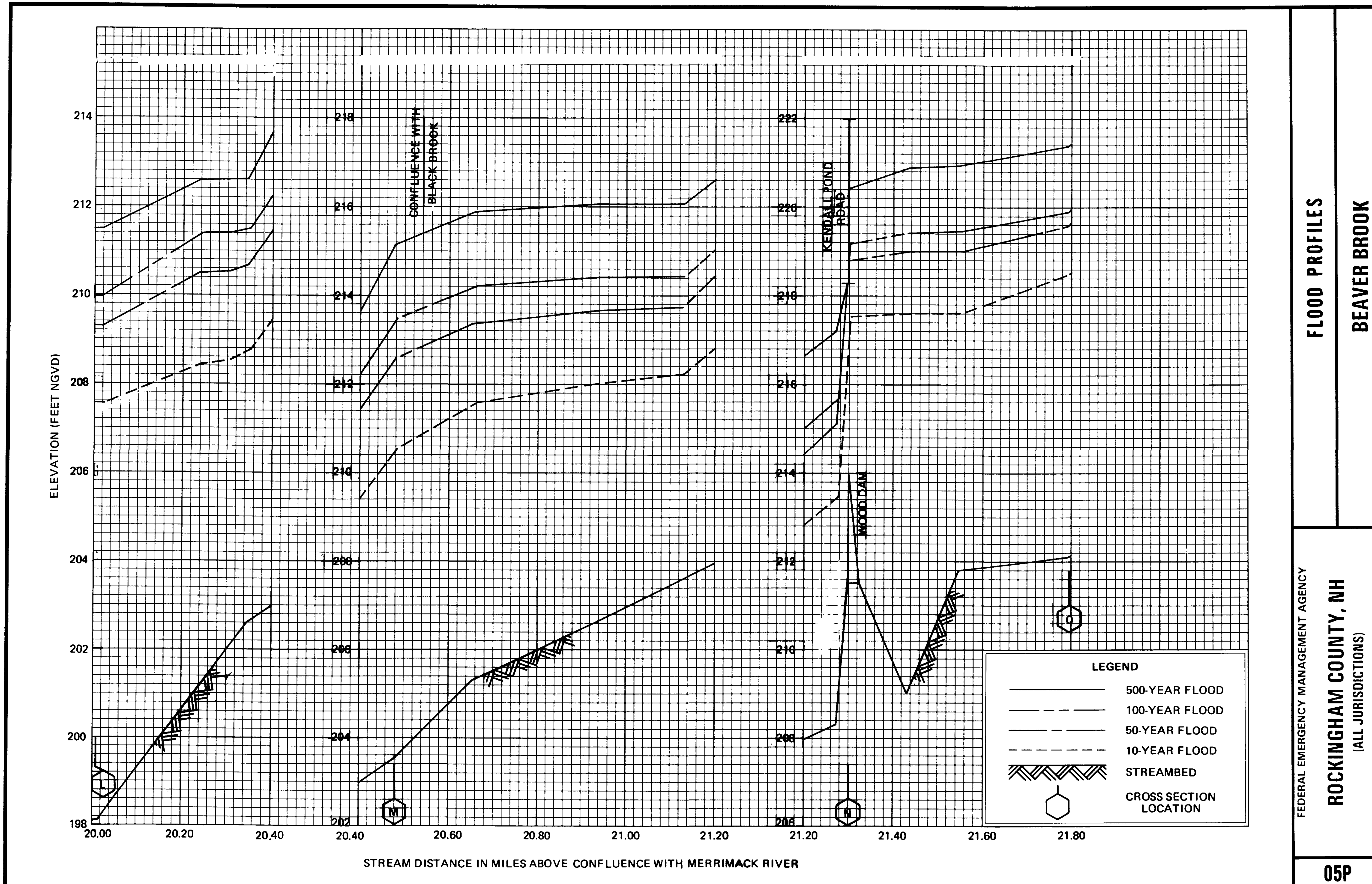
BEAVER BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

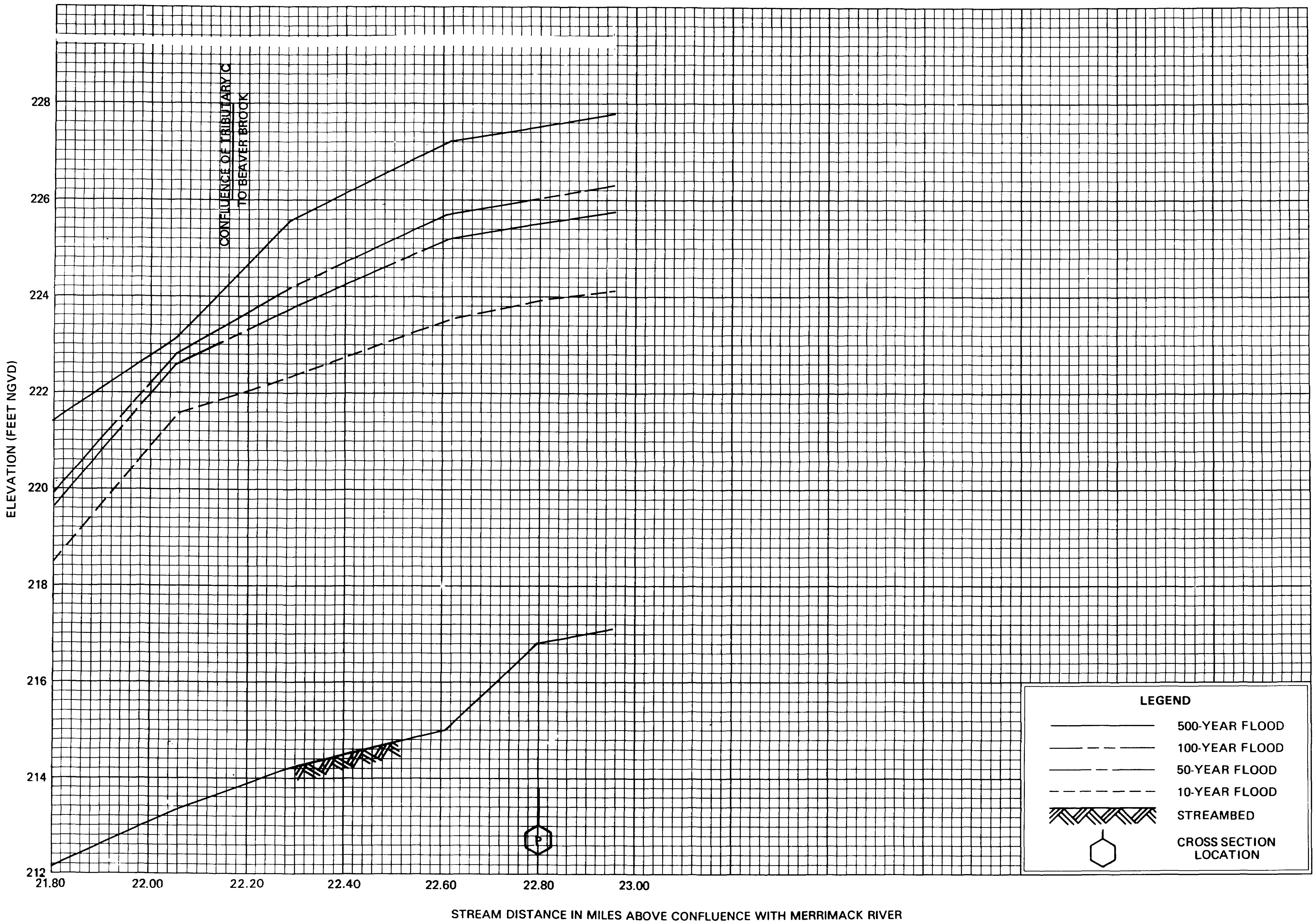
ROCKINGHAM COUNTY, NH

(ALL JURISDICTIONS)

04P



ELEVATION (FEET NGVD)
214
212
210
208
206
204
202
200
198
218
216
214
212
210
208
206
204
202
222
220
218
216
214
212
210
208
206
CONFLUENCE WITH BLACK BROOK
KENDALL POND ROAD
WOOD DAM
20.00
20.20
20.40
20.40
20.60
20.80
21.00
21.20
21.20
21.40
21.60
21.80
STREAM DISTANCE IN MILES ABOVE CONFLUENCE WITH MERRIMACK RIVER
L
M
N
O
LEGEND
500-YEAR FLOOD
100-YEAR FLOOD
50-YEAR FLOOD
10-YEAR FLOOD
STREAMBED
CROSS SECTION LOCATION
FLOOD PROFILES
BEAVER BROOK
FEDERAL EMERGENCY MANAGEMENT AGENCY
ROCKINGHAM COUNTY, NH
(ALL JURISDICTIONS)
05P



FLOOD PROFILES

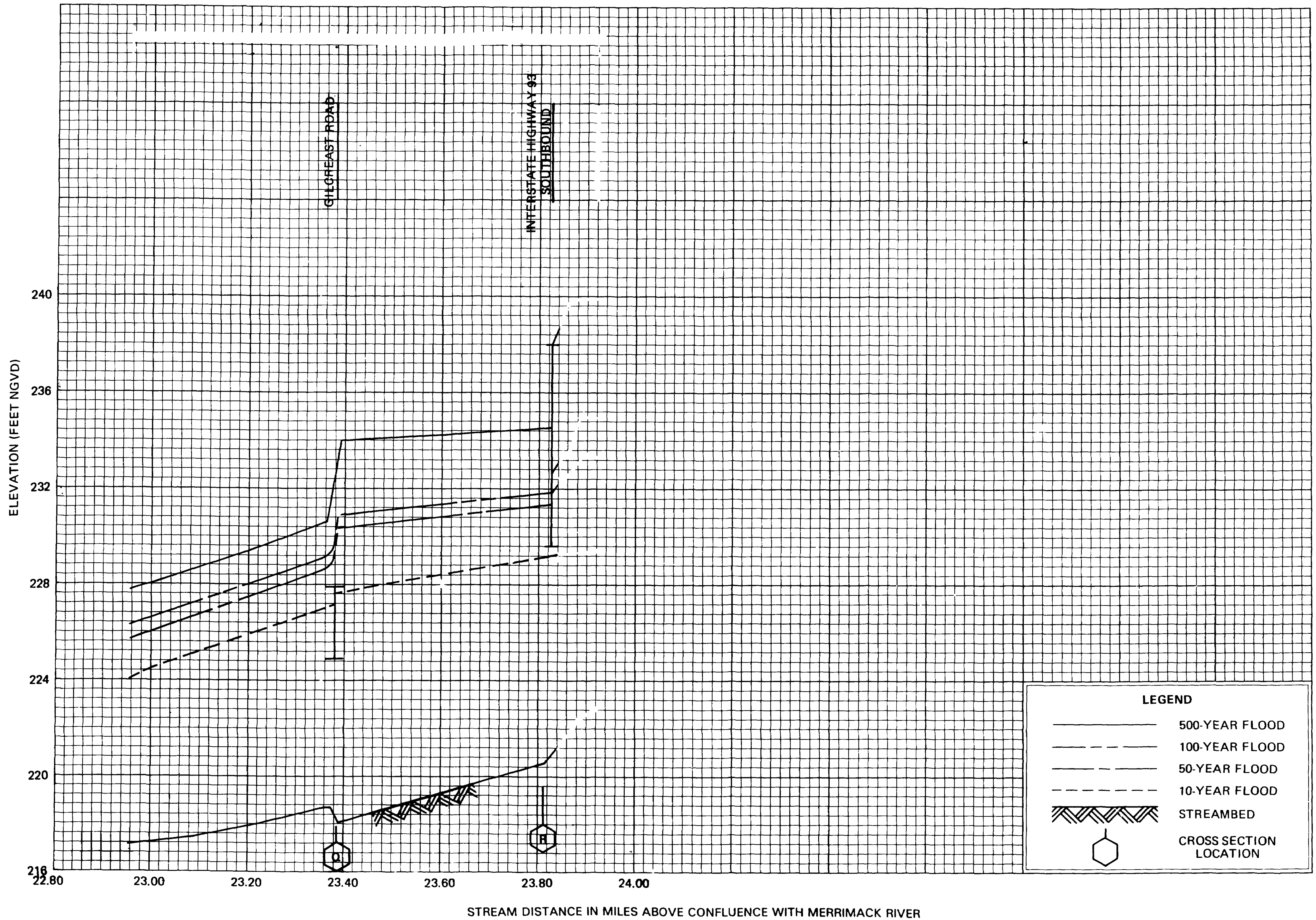
BEAVER BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH

(ALL JURISDICTIONS)

06P



FLOOD PROFILES

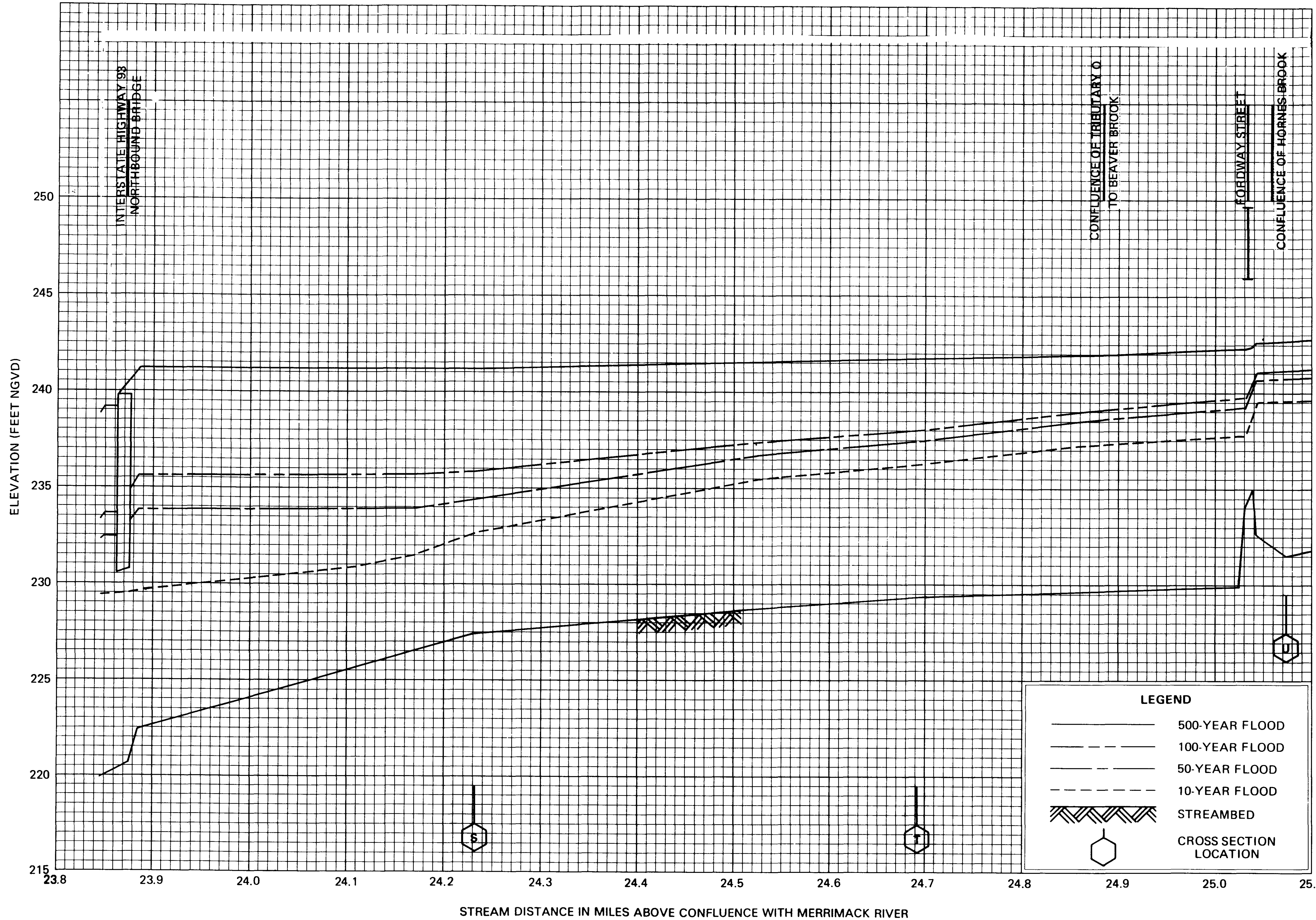
BEAVER BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH

(ALL JURISDICTIONS)

07P



FLOOD PROFILES

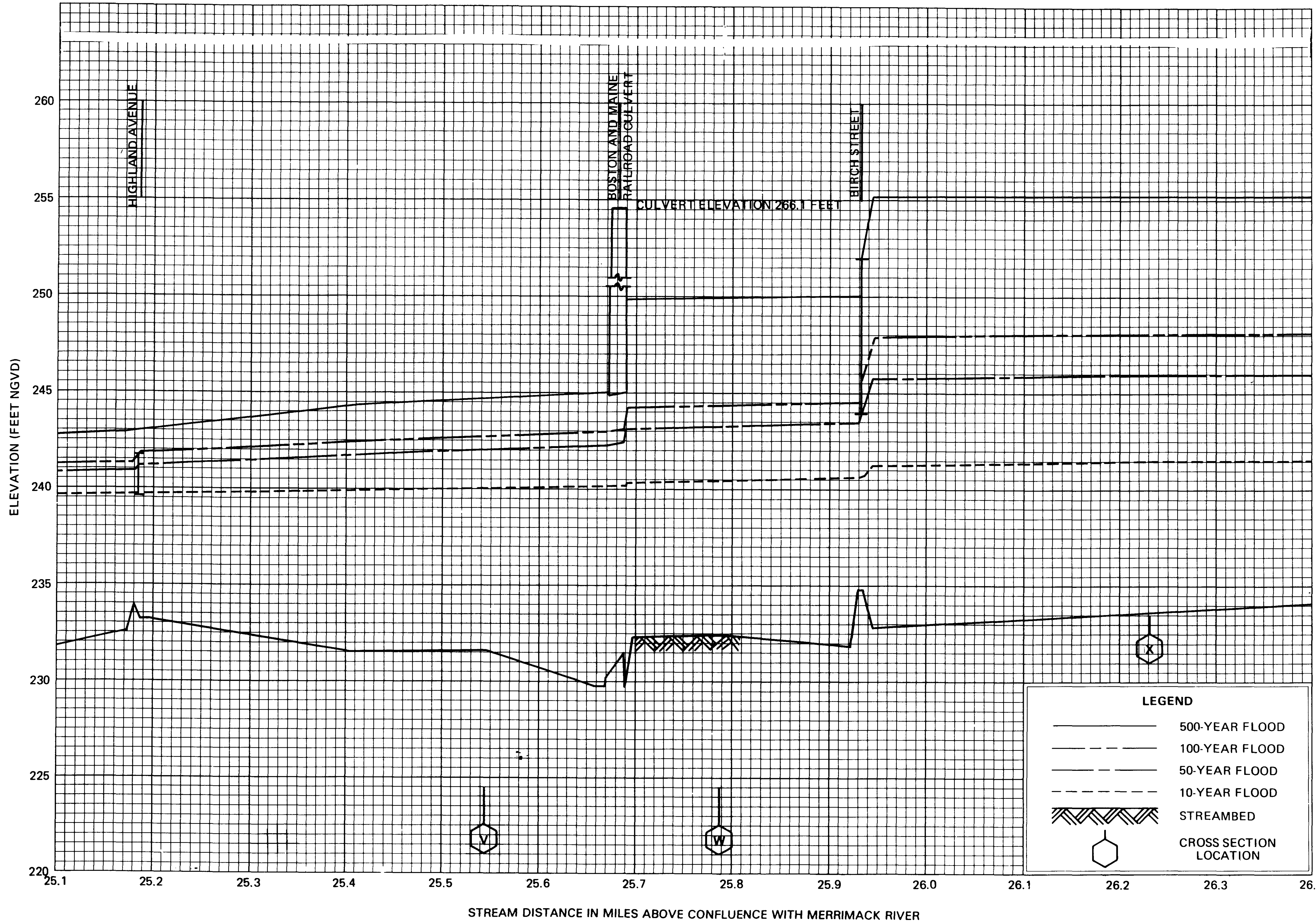
BEAVER BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH

(ALL JURISDICTIONS)

08P

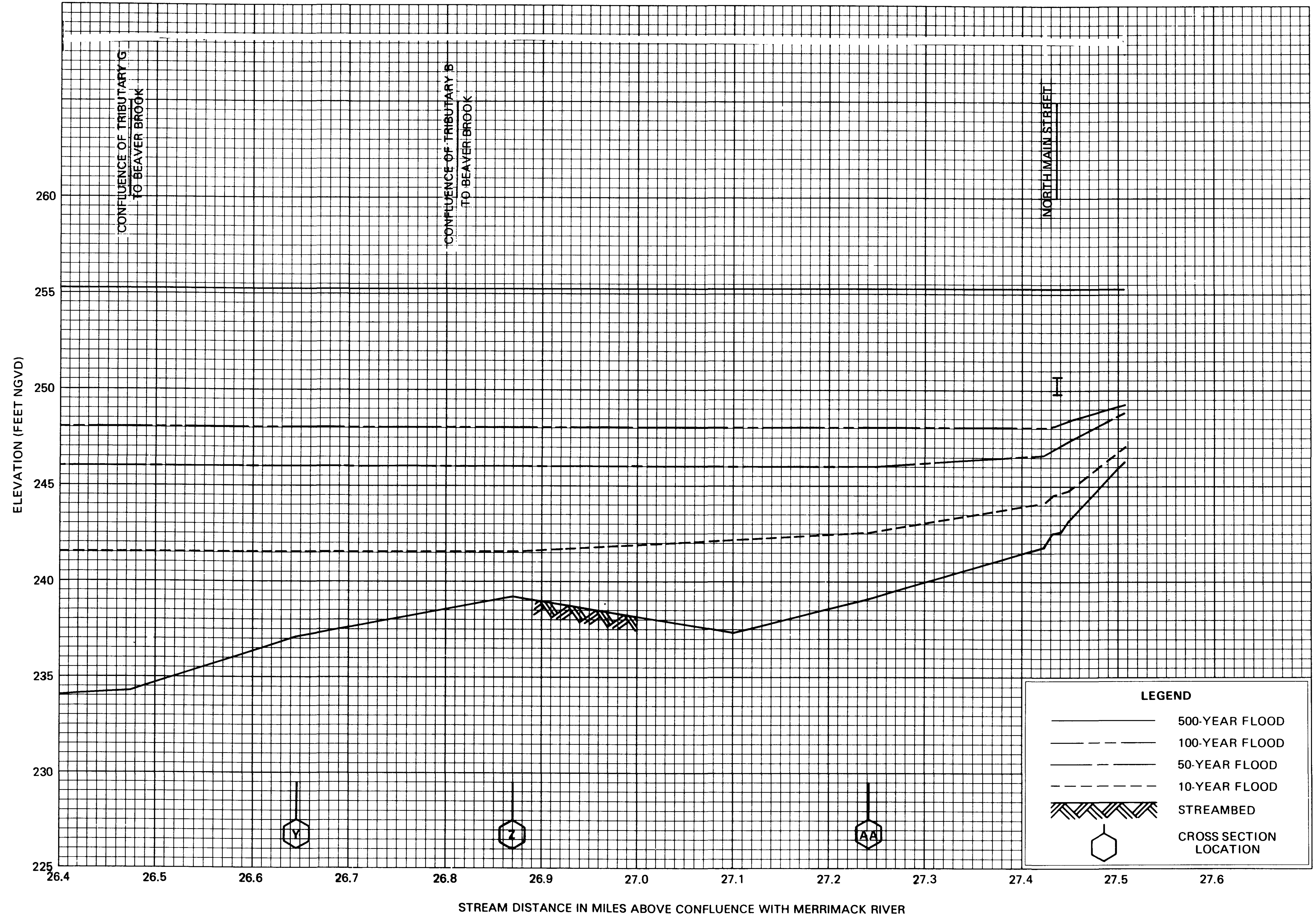


FLOOD PROFILES

BEAVER BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH
(ALL JURISDICTIONS)



FLOOD PROFILES

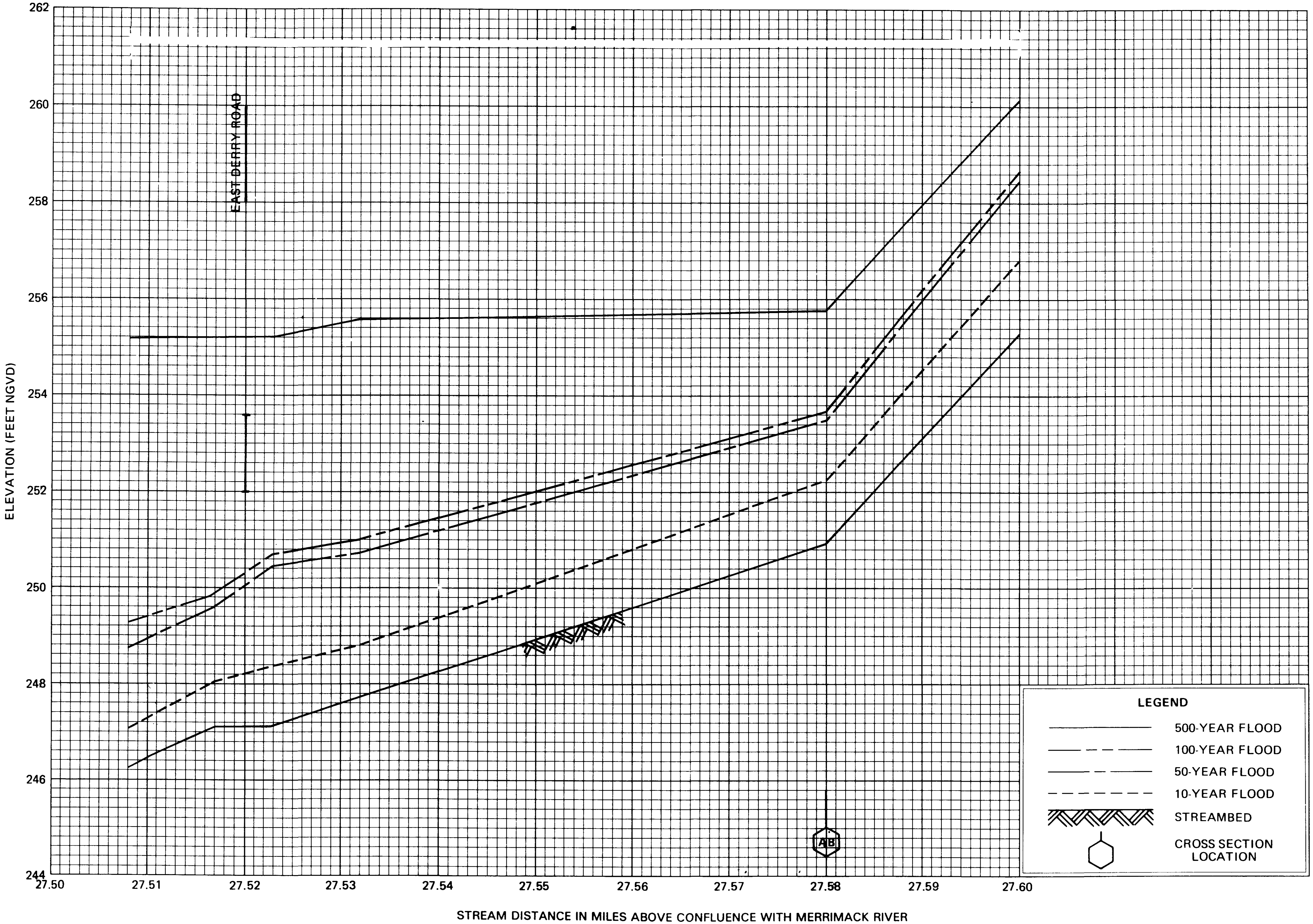
BEAVER BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH

(ALL JURISDICTIONS)

10P



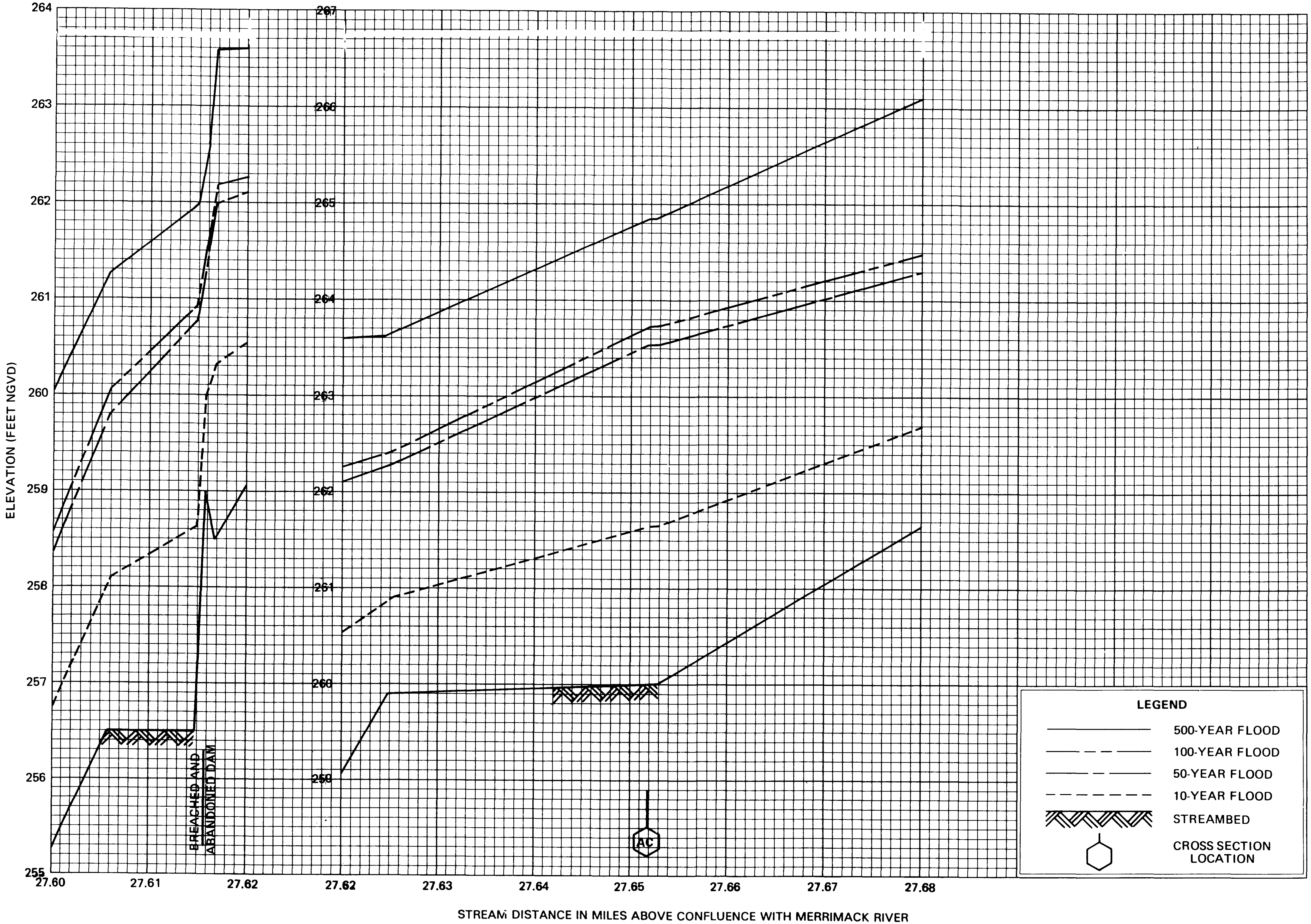
FLOOD PROFILES

BEAVER BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH

(ALL JURISDICTIONS)



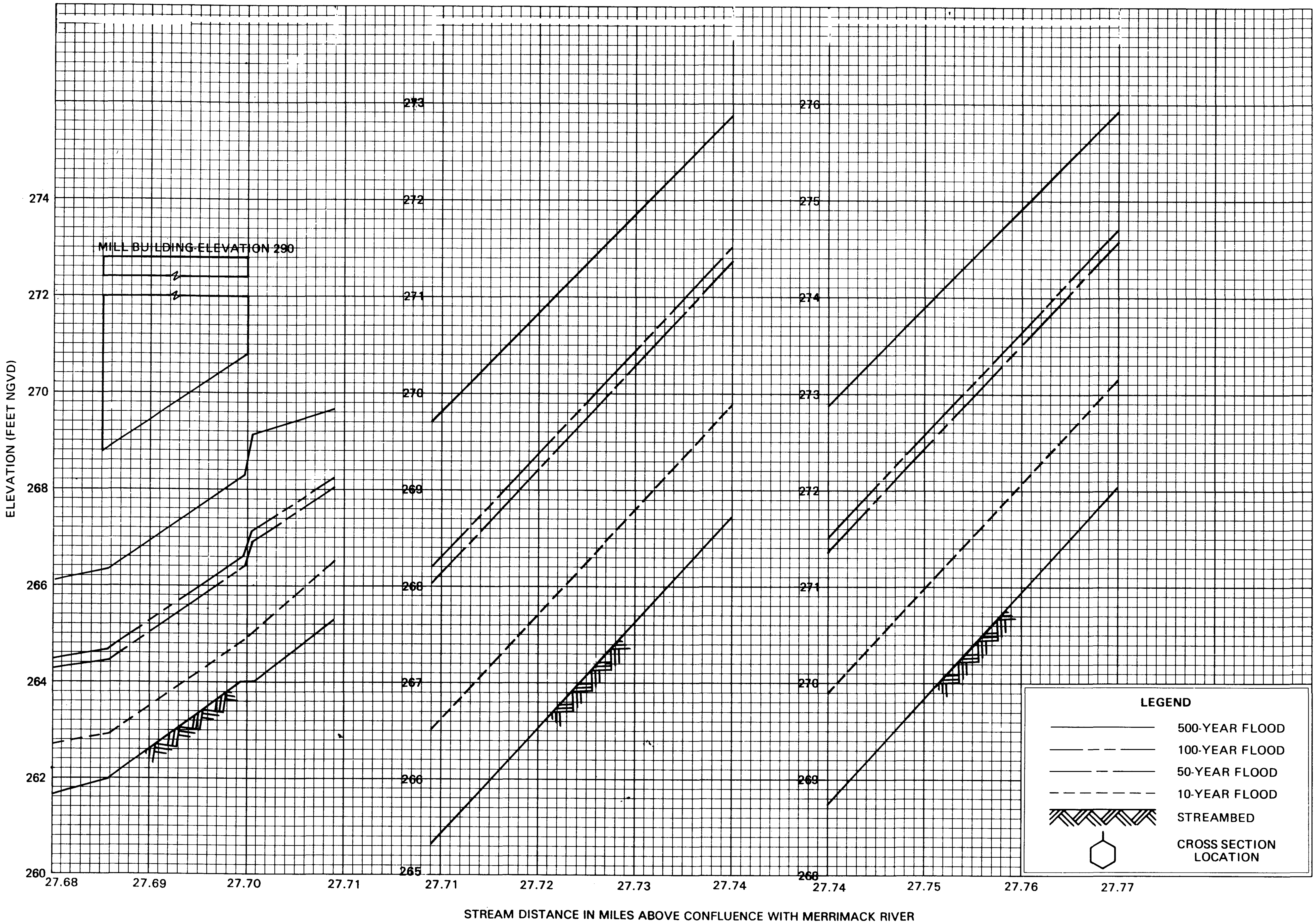
FLOOD PROFILES

BEAVER BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH

(ALL JURISDICTIONS)



FLOOD PROFILES

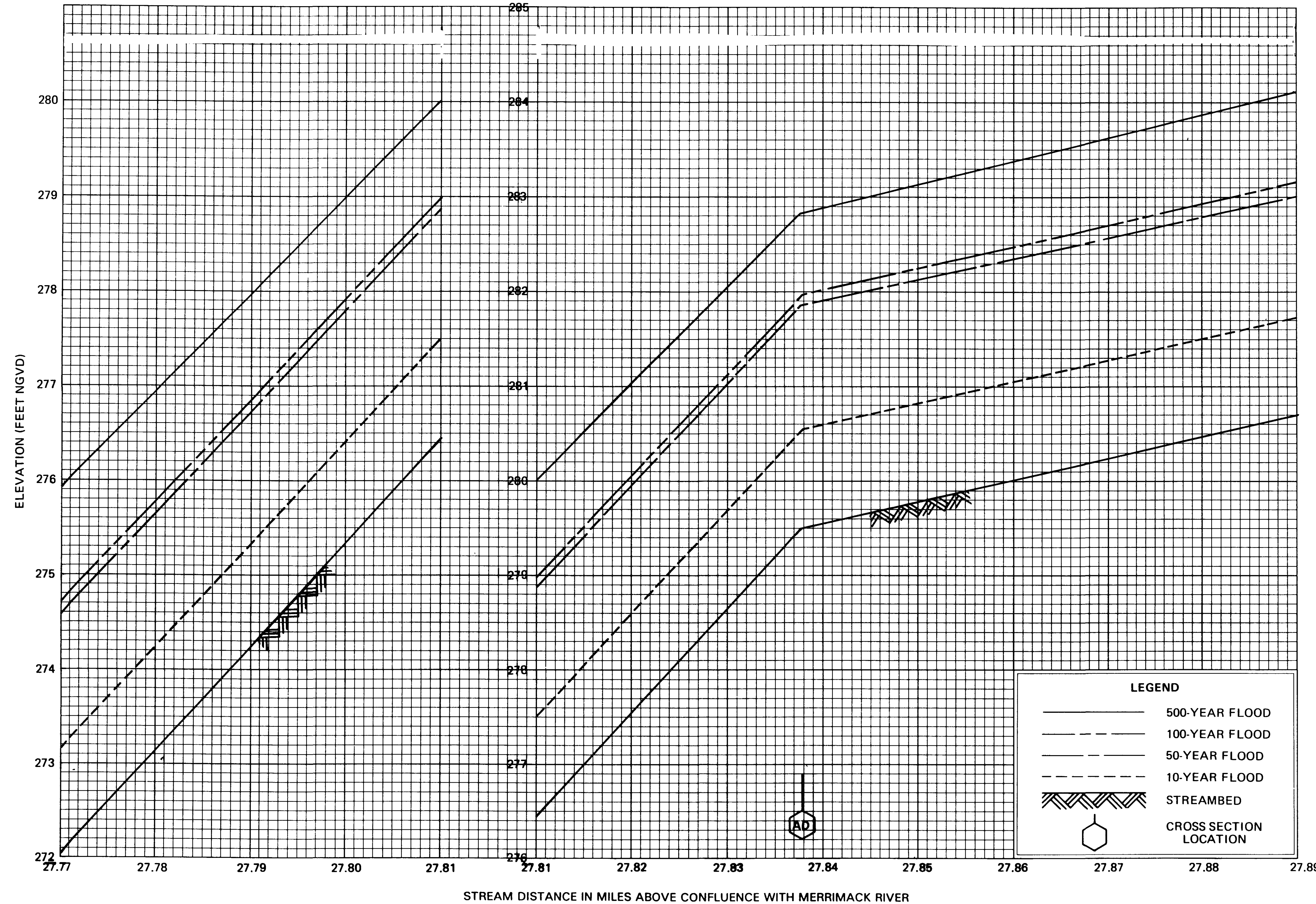
BEAVER BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH

(ALL JURISDICTIONS)

13P



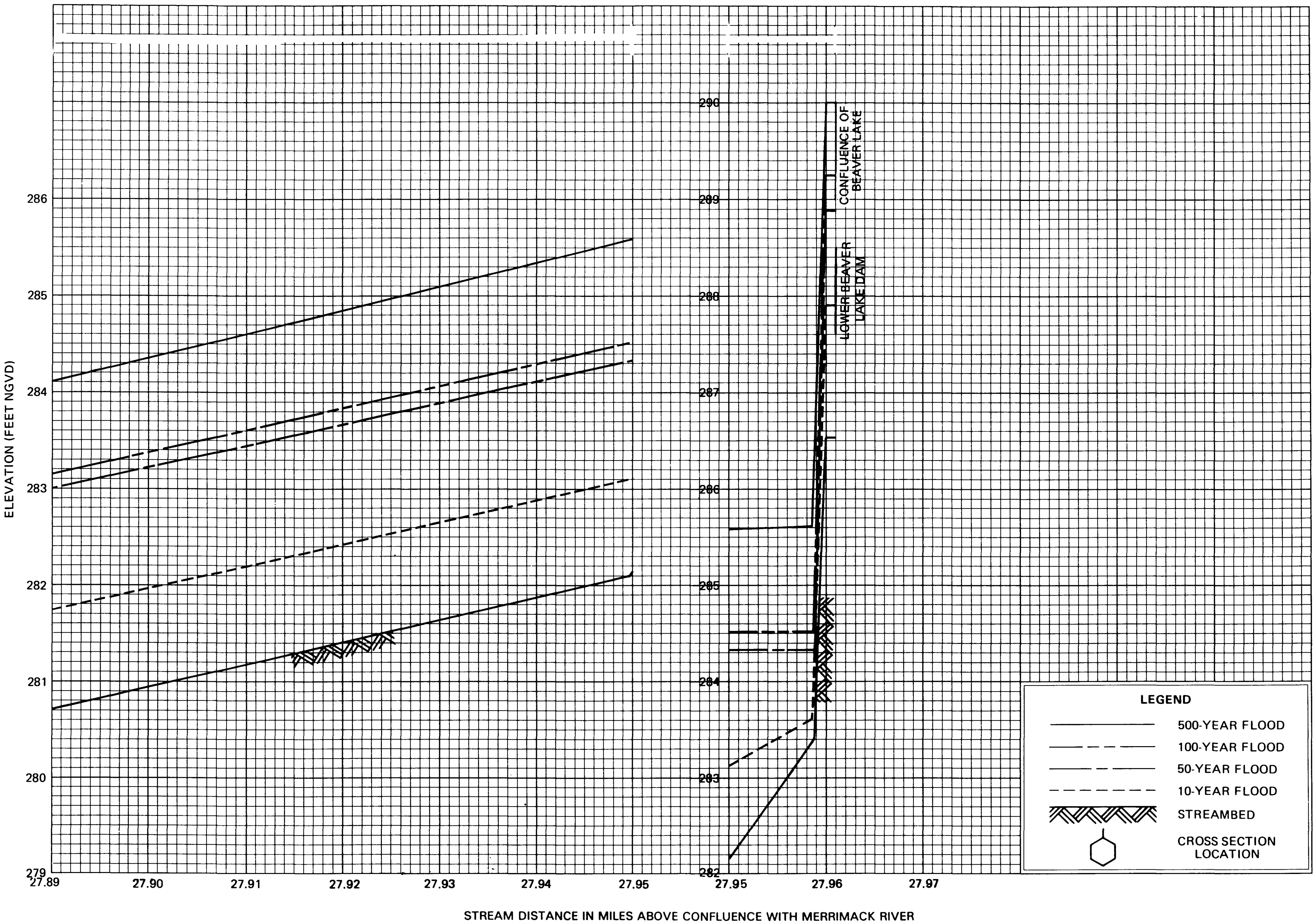
FLOOD PROFILES

BEAVER BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH

(ALL JURISDICTIONS)



FLOOD PROFILES

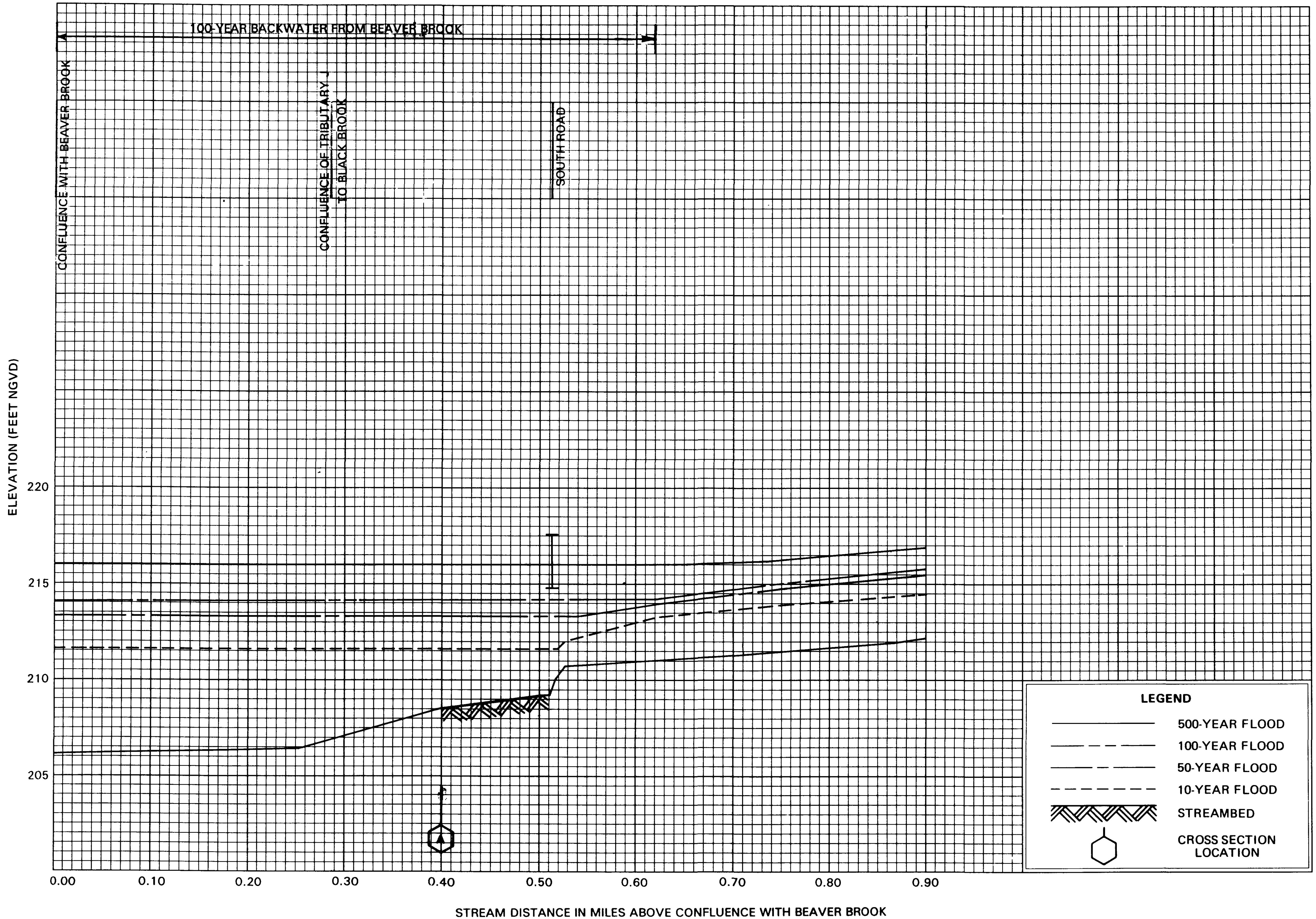
BEAVER BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH

(ALL JURISDICTIONS)

15P

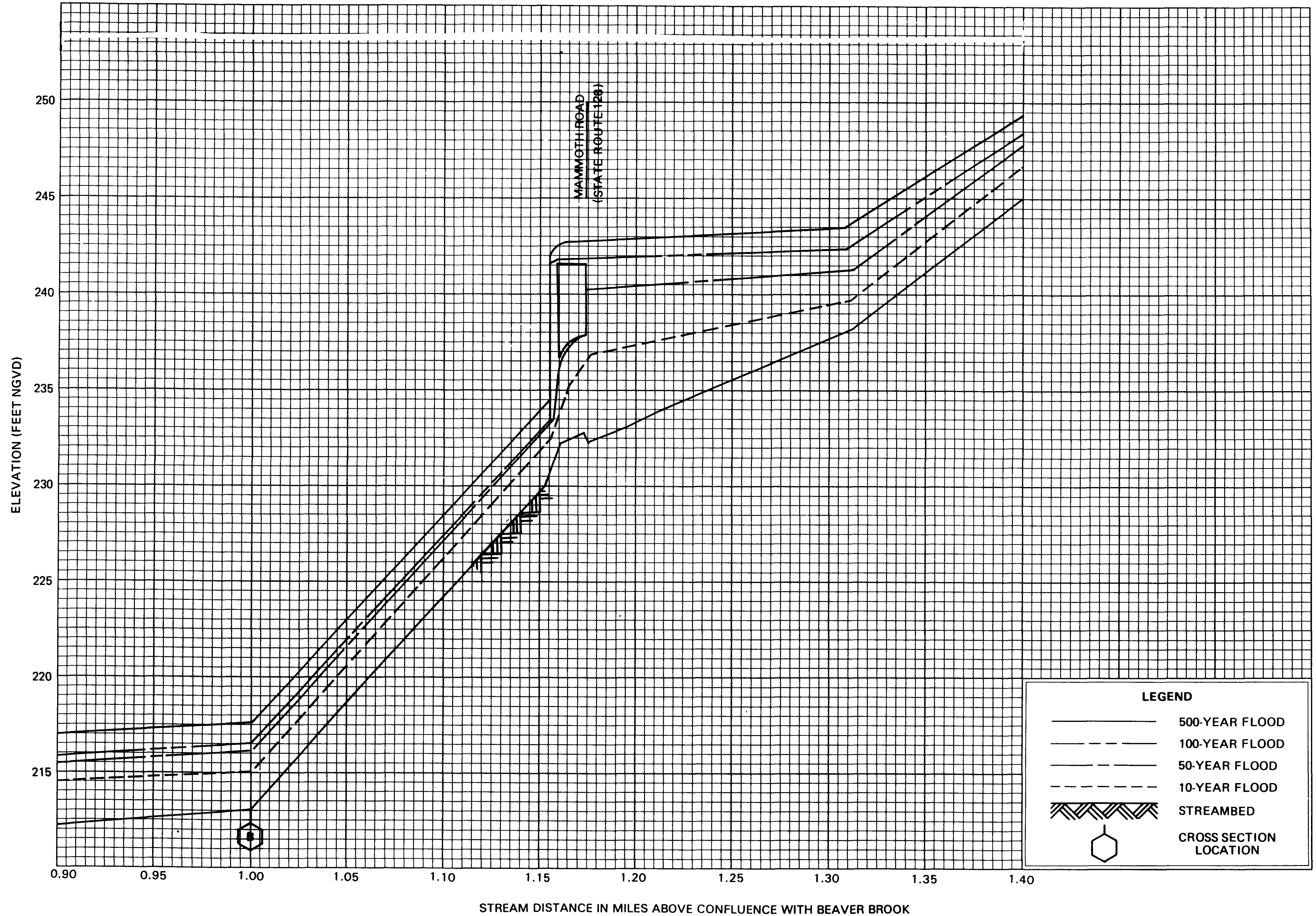


FLOOD PROFILES

BLACK BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH
(ALL JURISDICTIONS)



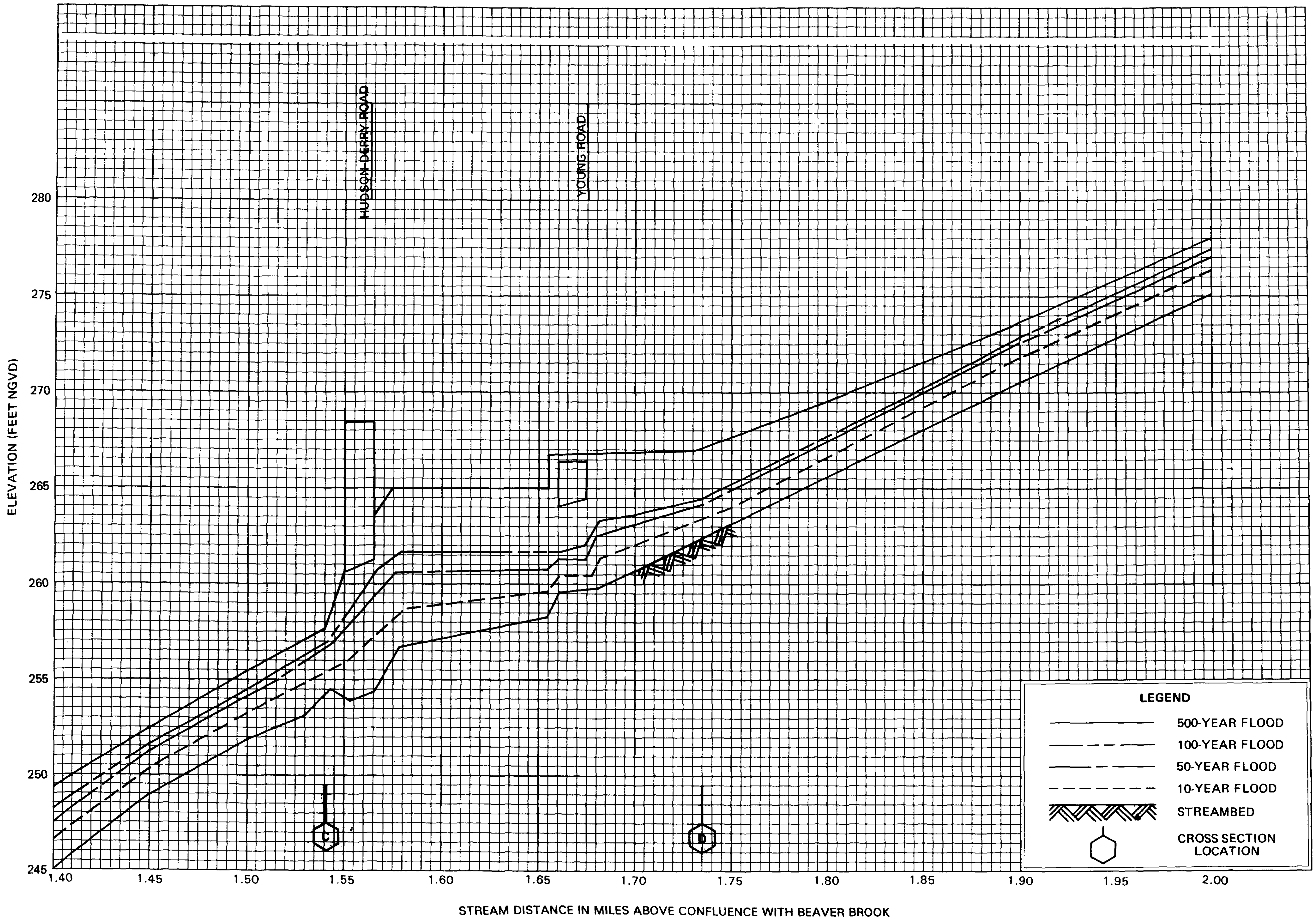
FLOOD PROFILES

BLACK BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH

(ALL JURISDICTIONS)



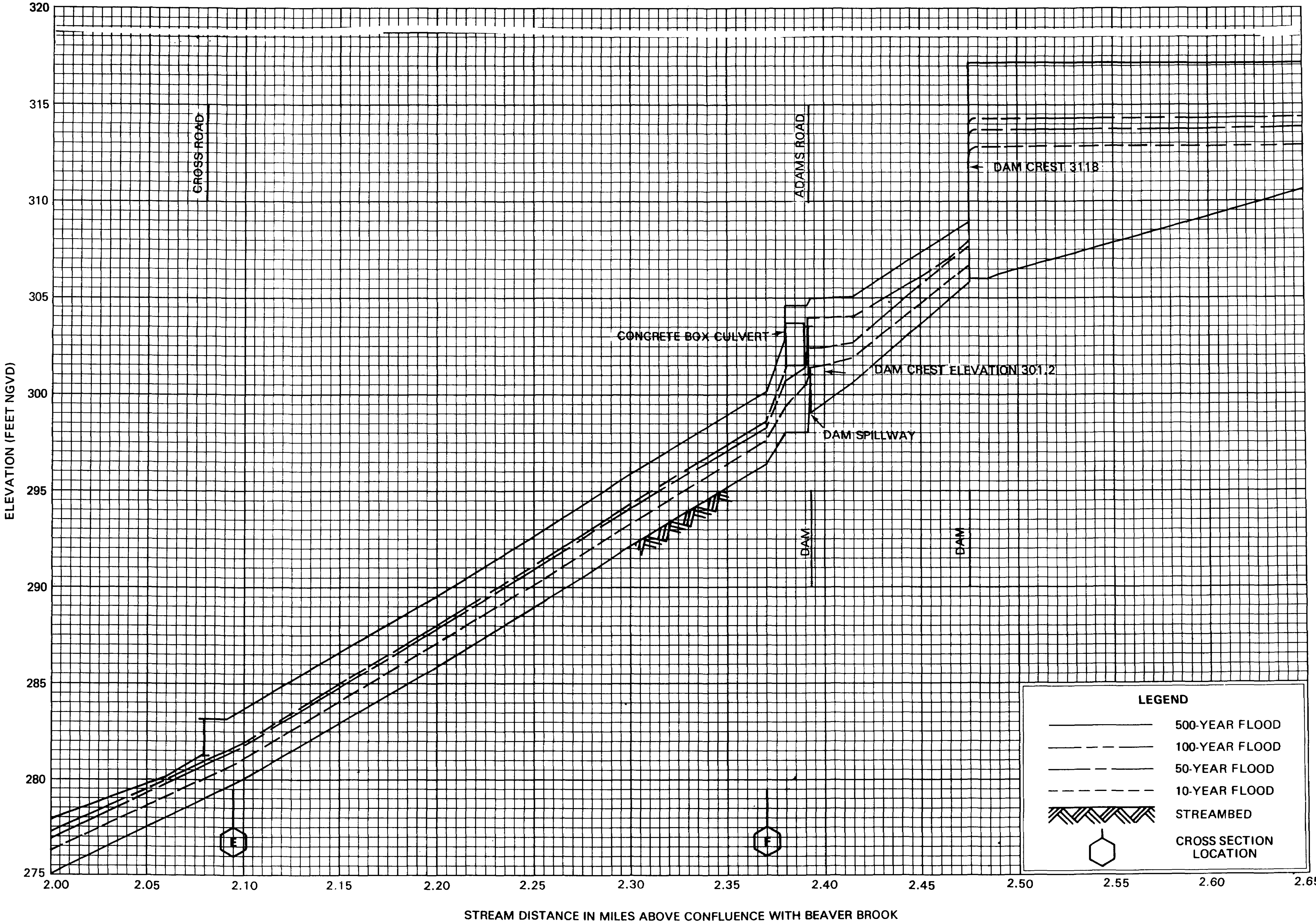
FLOOD PROFILES

BLACK BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH

(ALL JURISDICTIONS)

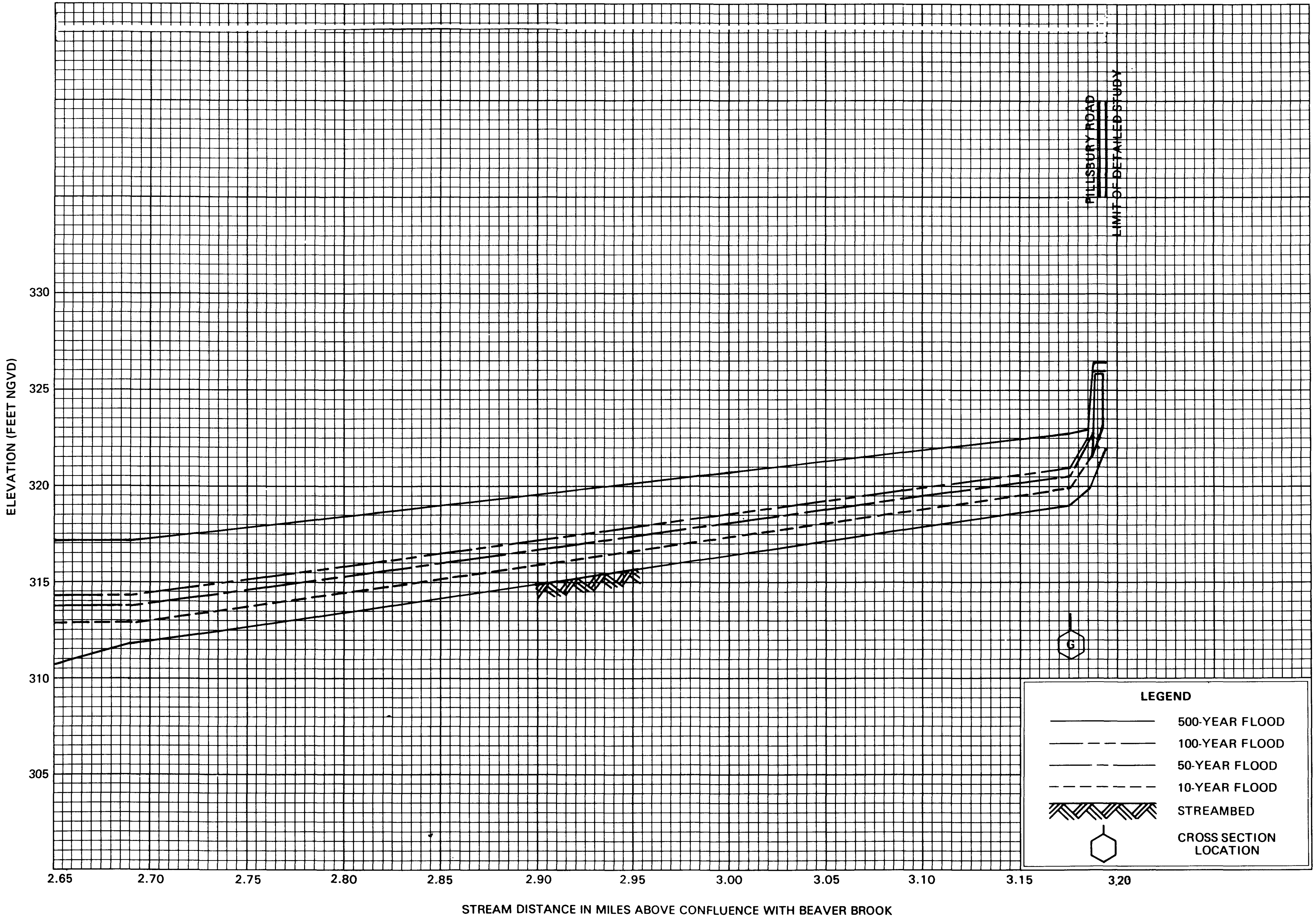


FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH
(ALL JURISDICTIONS)

FLOOD PROFILES

BLACK BROOK



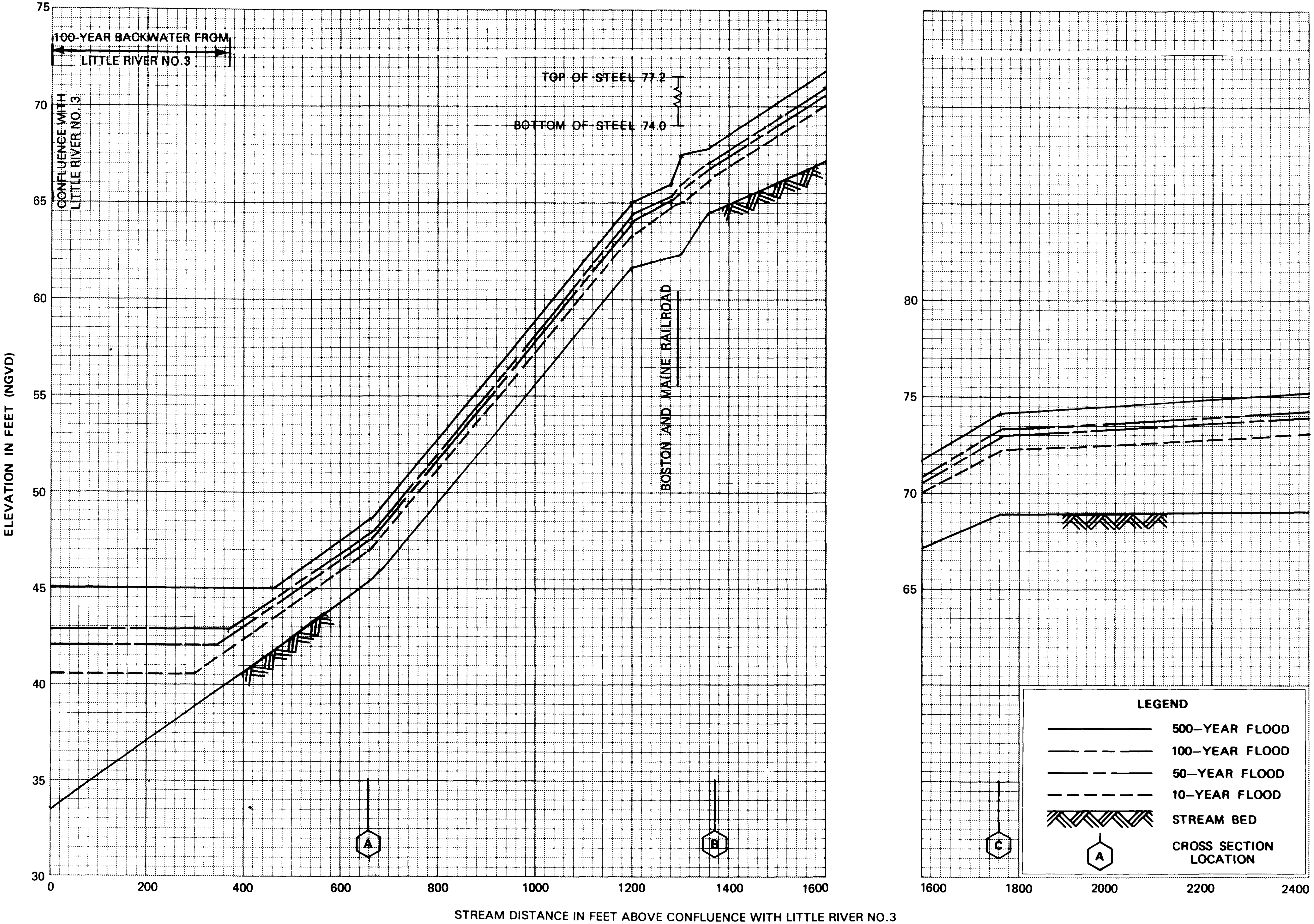
FLOOD PROFILES

BLACK BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH
(ALL JURISDICTIONS)

20P



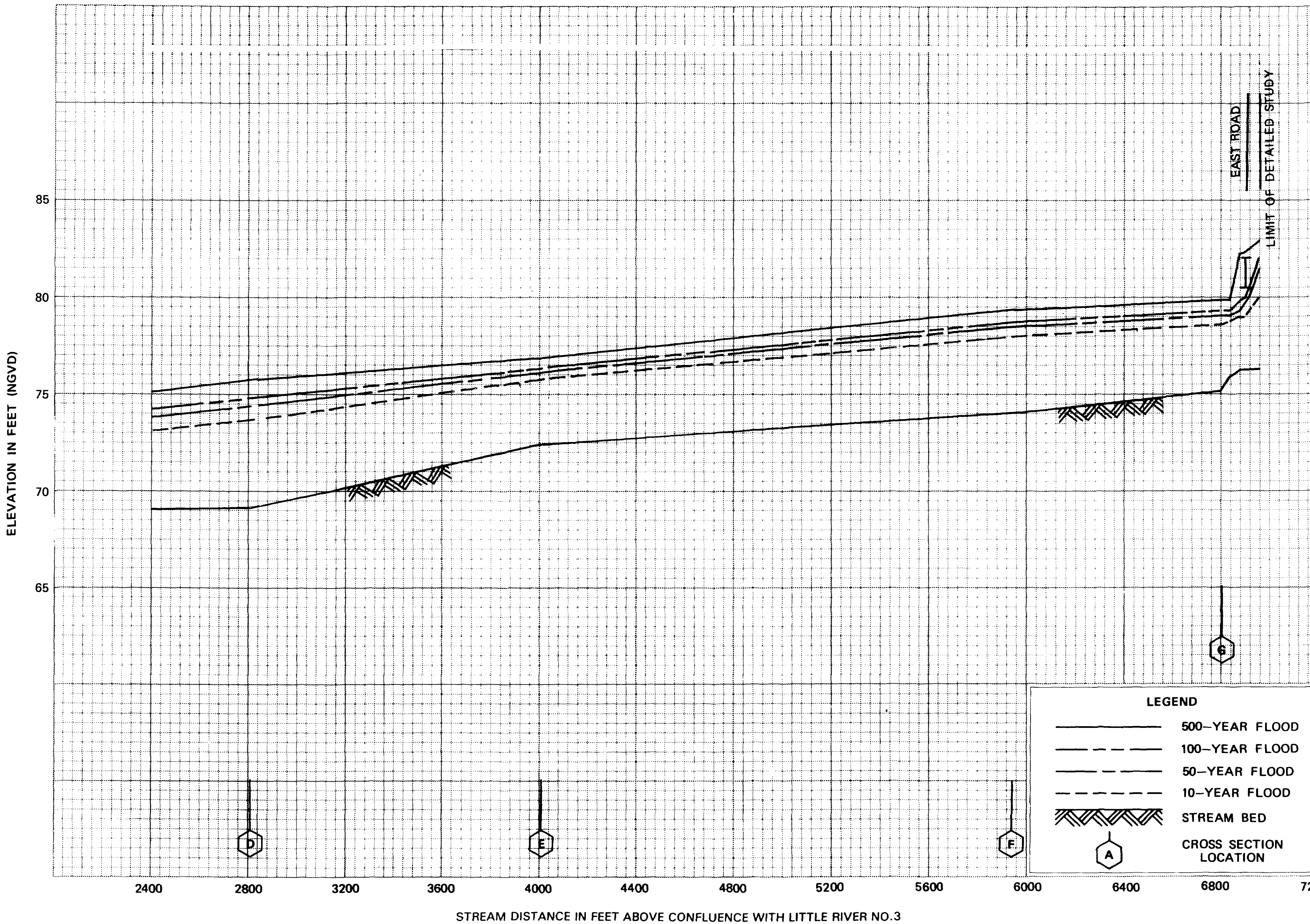
FLOOD PROFILES

BRYANT BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH
(ALL JURISDICTIONS)

21P



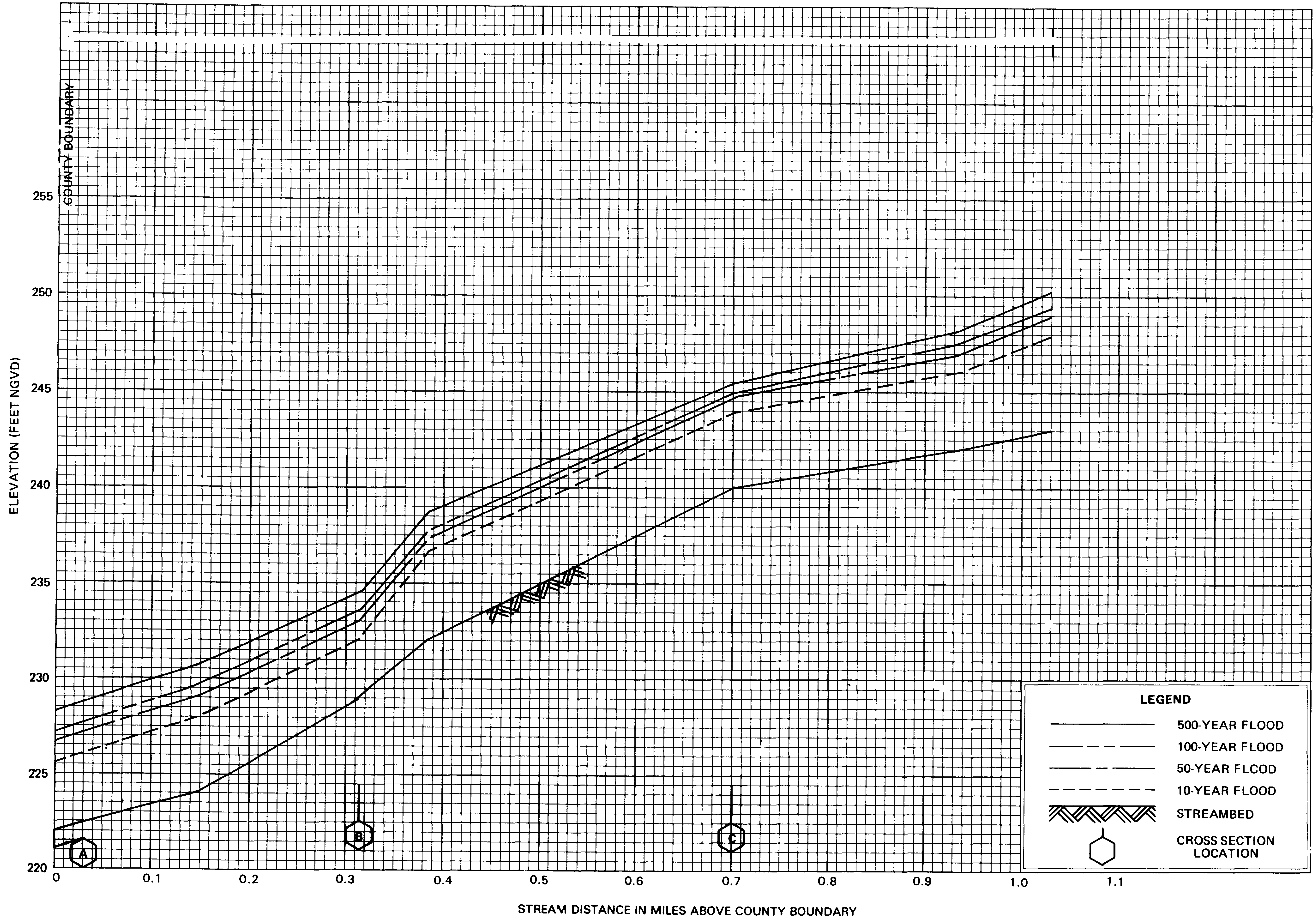
FLOOD PROFILES

BRYANT BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH

(ALL JURISDICTIONS)



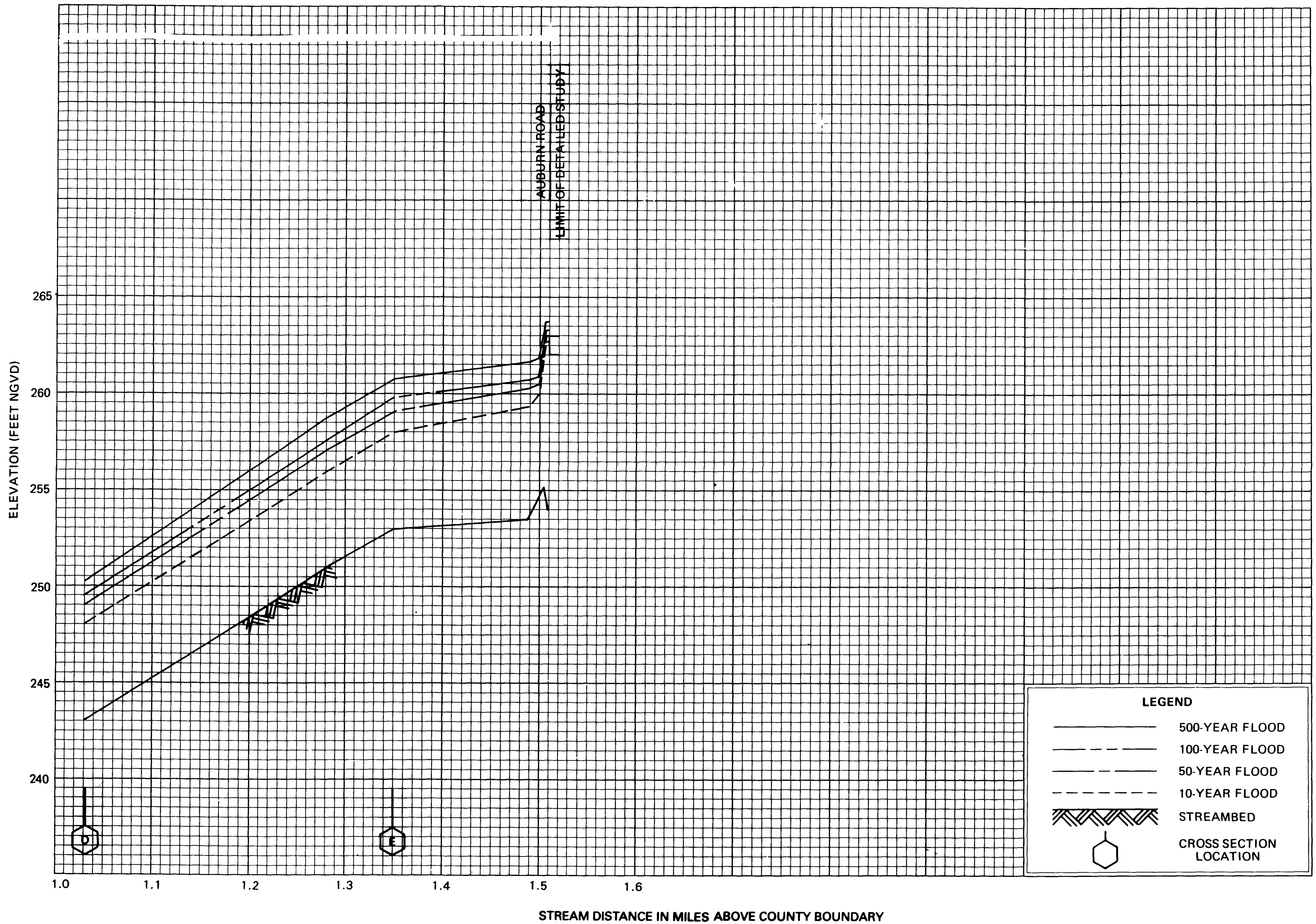
FLOOD PROFILES

COHAS BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH

(ALL JURISDICTIONS)



FLOOD PROFILES

COHAS BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ROCKINGHAM COUNTY, NH

(ALL JURISDICTIONS)